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ROENTGENOGRAPHIC CHANGES FOLLOWING THE INTRODUCTION OF MINERAL OIL IN THE LUNG[1]

WITH REPORT OF THREE CASES

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From the X-ray Laboratory, St. Vincent's Hospital

MINERAL oil has been used for many years in the treatment of certain of the diseases of the respiratory tract but only within the past ten years has attention been directed to the possibility of pathologic sequelæ to oil within the lungs. The earlier reports of lung injuries were those in which accidental aspiration of oils had occurred in young and debilitated infants. Cases of this nature have been reported by Goodwin (14), Grayzel and Du Mortier (15), Laughlen (22), Pinkerton (27), Rabinovitch and Lederer (30) and by Pollak and Potter (29). Most of their cases had been diagnosed clinically as bronchopneumonia, the correct diagnosis having been made at autopsy. The fundamental pathologic process was found to have been the presence of numerous large mononuclear phagocytes containing oil droplets and the marked proliferation of the connective tissue in the alveolar walls. The type and the degree of the reaction varied, depending on the amount and the duration of the oil in the lung prior to autopsy.

Up to the present time only five instances of fatal lung injury in adults, due to oil, have been reported in the literature. One patient (33) had aspirated butter fat because of cardiospasm; in another (19) the source of the oil was not determined; Laughlen's patient (22), who had a laryngeal paralysis, was given naso-pharyngeal instillations of mineral oil. In the remaining two cases (4, 10), the condition followed prolonged use of large amounts of mineral oil in the nose. In all of these cases the secondary fibrosis was the most significant part of the pathologic findings.

Pinkerton (28), in a series of experiments on dogs and rabbits, definitely proved that the intratracheal instillation of mineral oil produced marked pulmonary changes, consisting of fibrosis of the alveolar walls together with the presence of large numbers of greatly swollen phagocytes, each of which contained numerous small droplets of oil. Pinkerton found that the vegetable oils produced but little reaction in the lung although in some of his animals the oil had been in the lung for several months before autopsy was done. Iodized vegetable oils occasionally caused minute abscesses, especially in areas in which there had been bronchial obstruction, but in most of his animals produced no changes.

In the x-ray laboratory at St. Vincent's Hospital we have observed three cases in which there were noted pulmonary changes following prolonged or intensive use of mineral oil in the respiratory tract. In all of these cases oil droplets were found in the sputum. In one of the cases, which went to autopsy, large amounts of oil were

[1] Presented before the Radiological Society of North America at the Twenty-first Annual Meeting, at Detroit, Dec. 2–6, 1935.

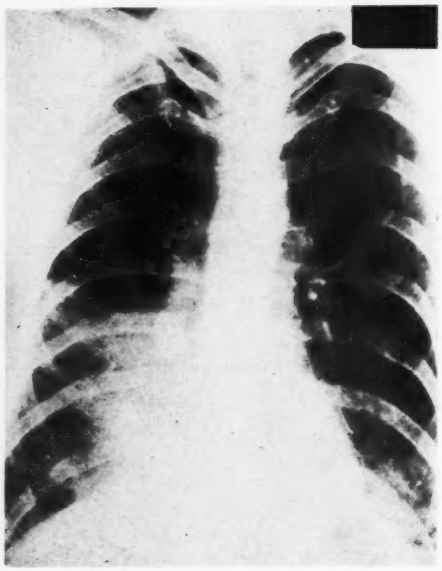

Fig. 1. Case 1. Chest roentgenograms taken Oct. 26, 1928, two months after onset of the patient's symptoms. The characteristic findings are an increased density in the mesial portion of the lower left lobe and an increase in the density of the entire lower right and middle lobes of the lung. The upper margin of the area of involvement on the right side is very clear-cut. Above this the lung-fields are normal in density. In the areas of involvement there is a pseudo-granular mottling which is due to a marked increase in the prominence of the finer lung markings. The distribution is atypical for military tuberculosis and there was no history suggesting the possibility of a pneumoconiosis. The condition was thought to have been a bronchiolitis fibrosa obliterans prior to autopsy. However, when the autopsy findings are taken into consideration these prominent fine lung markings can best be interpreted as markedly thickened alveolar walls.

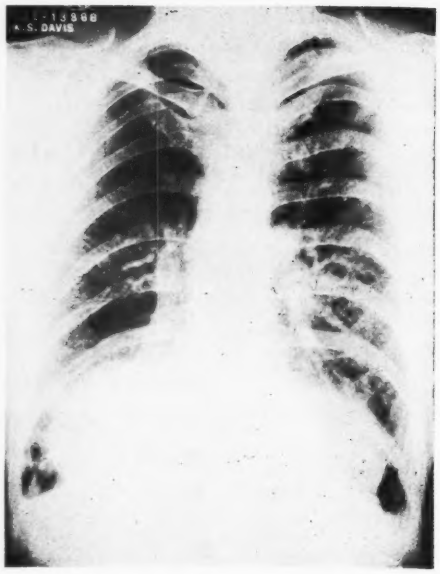

Fig. 2. Case 1. Chest roentgenogram three years later. Note the retraction in size of the right lower and middle lobes and the bilateral increase in density of the mesial portions of the bases of both lower lobes. In the right lower lobe there is a peripheral zone of air-containing tissue surrounding the solidified area, definitely ruling out atelectasis. In roentgenograms made in 1932 there was a further retraction in the size of the right lower lobe but the solidified areas remained unchanged in size.

found in the lung, the oil being identified as mineral oil by chemical tests. This patient had had no oil administered for a period of six years and eight months prior to the autopsy.

From the study of these cases we believe that a rather characteristic roentgenographic picture is produced when an excessive amount of mineral oil is placed in the lung. In the early stages of the disease the roentgenographic picture is not unlike that of a bronchiolitis fibrosa obliterans, with a characteristic miliary mottling in the areas of involvement. The predominant pathology is on the right side, although the involvement in the lower left lung-field is quite extensive.

When the roentgenograms are closely scrutinized the mottling is seen to be due to a marked accentuation of the finer lung markings (Fig. 1). Before the autopsy we had interpreted these as evidence of bronchiolitis but, when the autopsy findings are taken into consideration, they can best be interpreted as markedly thickened alveolar walls, sufficiently large to be visualized on the roentgenogram.

In one of our cases follow-up roentgenograms were made over a period of six years, the roentgenographic findings later being correlated with the findings at autopsy. A review of the successive films in this case shows a definite progressive retraction in size of the involved lobes of the lung, together with a progressive solidification at the sites of maximum involvement. The

condition was *not* due to atelectasis as there was a peripheral zone of air-containing tissue in the involved lobes (Fig. 2), which persisted until the lobe was almost completely solidified. In the final roentgenogram, which was taken more than six years after the onset of symptoms, the involved lobes on the right side persisted only as "fibrous" remnants with an increased translucency of the upper right lung-fields due to compensatory expansion of the upper lobe. At this stage in the patient's illness the respiratory symptoms became quiescent with a disappearance of the cough and sputum.

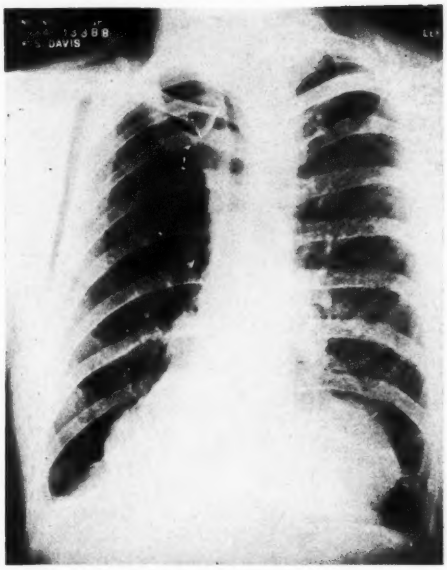

Fig. 3. Case 1. Chest roentgenogram taken six years after onset of symptoms. The right lower and middle lobes persist only as solidified remnants lying in the cardiohepatic angle. There is an increased translucency of the entire right lung-field due to compensatory expansion of the right upper lobe. The solidified area in the mesial portion of the lower left lobe remains unchanged in appearance from roentgenograms made in 1931. At this stage in the patient's illness the respiratory symptoms became quiescent, with no cough or sputum. On physical examination the right lung was found to be hyperresonant.

CASE REPORTS

Case 1. Patient, a male, 47 years of age, was admitted to St. Vincent's Hospital, Aug. 26, 1928, complaining of fever, malaise, and severe non-productive cough. For the preceding six months he had been treated for chronic irritation of the nasopharynx with occasional applications of liquid petrolatum which contained small amounts of thymol and menthol. *Within the two weeks preceding hospital entry an acute bronchitis had been treated with ten intratracheal instillations of the same oil.* At the time of entry, dyspnea and cyanosis were quite marked. There was an increased leukocytosis which reached its peak of 18,250 on Sept. 15, 1928. On physical examination there were found diminished resonance and broncho-vesicular breath sounds over the right lower lobe. No râles were heard. Convalescence was slow, the temperature reaching normal on the twentieth day. The patient was discharged in fairly good condition on Nov. 29, 1928. During the next four years his general health was fair although he suffered from frequent respiratory infections. In 1932, he was readmitted to the hospital with symptoms very similar to those observed on his first admission. This attack lasted five months. In 1934, the patient's respiratory symptoms became quiescent, with a disappearance of the cough and sputum. Physical examination at this time showed a disappearance of the dullness over the right base, this being replaced by a hyperresonance.

In April, 1935, another acute respiratory infection occurred and on April 19, he suddenly developed pulmonary edema and marked cyanosis. There was little response to treatment, death occurring after eight hours.

From 1932 to 1935, numerous sputum examinations had been made. No tubercle bacilli were found but *all specimens contained numerous oil droplets.* The clinical diagnosis was bilateral oil tumors of the lung resulting from the intratracheal instillations of mineral oil six years and eight months previously.

Autopsy Findings.—Gross Description of the Lungs: The upper lobes of both lungs were pale, soft, and markedly emphysematous. An oval-shaped mass was present at

Fig. 4. Case 1. Coronal section through the right lung. The right lower and middle lobes present themselves as solidified nodules. The "capsules" of the nodules were identified as the former pleural surfaces of these two lobes. The upper lobe was markedly emphysematous due to the compensatory expansion secondary to the contraction of the two lower lobes.

the base of each lung. These masses were hard and rubbery and were densely adherent to the parietal pleura. Sections through the mass in the right lung revealed two oval-shaped nodules circumscribed by tough fibrous capsules adherent to all surrounding structures. These "nodules" were identified as the remnants of the lower right and middle lobes and their "capsules" represented their former pleural surfaces (Fig. 4). On squeezing the nodules oil droplets collected on the cut surface. Similar findings were noted in the lower left lobe although this lobe was not as contracted as the two lower right lobes.

Microscopic Description: The air sacs were either reduced in size or obliterated. In certain areas the air spaces were filled with phagocytes containing numerous oil droplets. In others, the alveolus was entirely filled with a large vacuole which was encircled by a collar of mononuclear phagocytes. The alveolar walls were greatly thickened by nodules of lymphocytes and infiltrations of phagocytes containing vacuoles. The connective tissue in the alveolar walls was markedly thickened and condensed.

Roentgenographic Findings.—The first roentgenogram, made on Aug. 31, 1928, showed an increase in the density of the mesial portion of the lower left lobe, between the hilus and the left base, and an increase in the density of the entire middle and lower right lobes of the lung (Fig. 1). The upper margin of the involved area was very clear-cut; above this the lung-fields were normal in density. In the involved regions there were what first appeared to be areas of miliary infiltration giving the lung a definitely mottled appearance. However, when the film was carefully scrutinized these were found to be an accentuation of the finer lung markings which reached to the periphery of the lung-fields. The lung-fields in the vicinity of the cardiohepatic angle showed the greatest density; this area coincided with the location of the pathology in the lower left lobe.

A series of roentgenograms made in 1928, 1929, 1930, 1931, 1932, and 1934 showed right lower and middle lobes gradually retracting in size until, in roentgenograms made on Nov. 26, 1934, they persisted only as fibrous remnants lying near the cardiohepatic angle. In this film there was also noted a relative translucency of the entire right lung-fields due to compensatory expansion of the right upper lobe. Not only was there a retraction in the size of the right lower and middle lobes but there was a gradual increase in their density, beginning near the cardiohepatic angle, so that, in the roentgenograms made in 1931, there was a definite, rather sharply circumscribed area of solidification in this region, with only a limited peripheral zone of air-containing tissue remaining. Similar changes were noted in the lower left lobe, but to a lesser

degree owing to the more limited involvement on this side (Figs. 2 and 3).

Case 2. Patient, a male, 52 years of age, post-office clerk by occupation, consulted an otolaryngologist in 1930, complaining of chronic nasal discharge and chronic sore throat of many years' duration. He was treated by intratracheal instillations of liquid petrolatum containing small amounts of menthol and thymol, ten treatments being given. He did not improve and as the course of the illness was marked by frequent respiratory infections he was referred to Dr. Bennett for examination. At this examination in March, 1931, there was found a definite impairment of resonance over the lower left lobe and to a lesser degree over the right subclavicular area. Râles were heard over the lower left third of the lung, posteriorly.

A productive cough appeared in May, 1933, and by November, 1933, dyspnea was so marked as to prevent his working. At this time it was noted that his fear of the dryness of the nose and throat had become almost an obsession and it was learned that he had obtained a syringe with which he gave himself frequent intratracheal instillations. Usually the oil used was liquid petrolatum which at times contained menthol and thymol. In addition to these procedures he frequently saturated pledgets of cotton with petrolatum and inserted these into the nostrils. All of these treatments were self-administered without the knowledge of his physicians and the amounts of oil used and the intervals between the instillations are unknown. His sputum contained no tubercle bacilli but did contain numerous small oil droplets similar to those found in the sputum of Case 1. No chemical identification of the oil was attempted. The dyspnea and cough became progressively worse; there was considerable loss of strength and of weight. He died in June, 1934. Permission for autopsy was not obtained.

Roentgenographic Findings.—Roentgenograms made in 1932 show an increase in the density of the right lung from the level of the clavicle to the base; however, the periphery of the right base is relatively clear. On the left side the area of increased density is limited to the lower left lobe, although there is not the sharp demarcation of this lobe that was seen in Case 1. Careful study reveals that the increase in density is due to an increase in the prominence of the finer lung markings, with very little, if any, pulmonary consolidation. These changes can best be described as a fine granular mottling (Fig. 5).

Fig. 5. Case 2. Chest roentgenogram made in 1932, two years after onset of symptoms. Roentgenographic findings are comparable with the early changes noted in Case 1 (compare with Fig. 1), but the distribution is more extensive. Later roentgenograms showed a progressive increase in the density of the involved areas, but the patient died before any definite retraction of the lungs had taken place.

Films made in 1933 show a progressive increase in the density of both lung-fields although there was not the retraction of the lungs that was seen in the first case.

Case 3. Patient, a male, 41 years of age, first consulted a physician in December, 1934, because of pain in the right chest, cough, and blood-tinged sputum. The present illness began in 1932, with a severe, almost paroxysmal, non-productive cough, this attack lasting about six weeks. The

cough has persisted since that time, usually following exercise or exposure to cold air. Sputum has been especially marked at night. The pain has been progressively worse during the past six months. Sputum examination made in December, 1934, in a lay laboratory, was interpreted as positive for tubercle bacilli.

The roentgenogram made on Jan. 9, 1935, showed an area of infiltration in the right lower lobe between the hilus and base above the level of the cardiohepatic angle. This was considered as atypical in location and appearance for pulmonary tuberculosis: the patient was advised to have the sputum examination repeated, which was done and no tubercle bacilli found. In six subsequent examinations the sputum has been repeatedly negative for tubercle bacilli but *all the specimens show oil droplets.* On questioning the patient it was learned that in 1926, on consulting an otolaryngologist he was advised to use mineral oil in his nose. Since this time he has used a nasal mineral oil douche consisting of three to four ounces of warm oil three or four times a day. The patient states that he has used approximately seven gallons of oil per year for a period of nine years.

A roentgenogram made Nov. 4, 1935, shows but little progress in the affected right lung but there are definite progressive changes observed in the lower left lobe. At the date of this examination the patient's general health was fairly good, although he still had attacks of paroxysmal coughing and blood-tinged sputum.

COMMENTS ON THE X-RAY FINDINGS

The roentgenographic changes noted in the early stages of the first two cases are comparable with the findings reported by Assmann (2), Doub (7), and Sante (31), except that they are more limited in extent. These findings consist of an increased density in the areas of involvement, best described as a miliary mottling. However, when the films are carefully scrutinized the miliary areas are found to be prominent, fine lung markings—an important differential point in distinguishing this condition from bronchiolitis.

The series of roentgenograms made (from 1928 to 1934) in Case 1, show a progressive contraction and solidification of the involved lobes until they persisted only as completely solidified remnants. Atelectasis could be definitely excluded by the zone of air-containing tissue surrounding the central zone of increased density.

GENERAL COMMENTS

1. Unusual roentgenographic findings are noted following the introduction of large amounts of mineral oil in the lung.
2. These findings consist of a miliary mottling in the areas of involvement which, when closely scrutinized, are found to be an accentuation of the finer lung markings.
3. With progression of the disease there is a progressive contraction of the involved lobes and a progressive solidification at the sites of the maximum involvement.
4. In all of our cases oil droplets were consistently found in the sputum months, even years, after oil had been discontinued as a therapeutic measure.
5. In one case which went to autopsy, oil was recovered in the lung six years and eight months after the last intratracheal instillation, and was identified as mineral oil by chemical methods.

I wish to thank Edwin S. Bennett, M.D., John Budd, M.D., A. S. Granger, M.D., George H. Houck, M.D., for their cooperation in the presentation of the clinical and pathologic data on Cases 1 and 2.

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DISCUSSION

DR. LEO RIGLER (Minneapolis, Minn.): I think Dr. Davis is to be highly complimented on his presentation. It has brought home an extremely important point for us to remember. With the increased use of intratracheal and intranasal medication with oil, we perhaps will see more of these cases. We are all aware of the presence of so-called lipoid pneumonia in children and young infants which has been reported on a number of occasions, as he pointed out, but I was personally quite unaware of the presence of this same lesion in adults until just shortly before I left home. Then I had occasion to see one of these cases at autopsy—a case in which the diagnosis was not made before the autopsy examination—and the findings there were almost identical with those which Dr. Davis has described.

It seems to me that the striking thing about these is the extreme fibrosis which is present and which he has demonstrated. This may, in the unilateral cases, lead to the diagnosis, as it did in the case I happened to see, of a tumor, bronchogenic carcinoma, or other tumor which is producing gradually an atelectasis.

Another noteworthy feature of these cases is the long-standing character of the process and this also may represent the findings that one might ordinarily get with a tumor.

I was glad that he brought out the difference in the reaction to vegetable oils from mineral oils, because, with the reporting of these cases, many of us have been led to fear the effects of iodized oil and the possibility that the instillation of iodized oil, particularly as it is used for therapeutic purposes, might produce some such process. There have been some reports to that effect although they are so few and far between it seems hardly probable that iodized oil could be responsible for such a lesion. I just want to emphasize the importance of considering this process as a possible explanation of a long-standing, slowly progressive fibrosis of one or both lungs.

BRONCHIECTASIS: ITS DIAGNOSIS AND TREATMENT[1]

By ARTHUR C. CHRISTIE, M.D., *Washington, D. C.*

THE opportunity to deliver the Carman Lecture is not only an honor but a high privilege. Through it, this Society honors the memory of a great physician. We take just pride and satisfaction in the fact that he was also a great radiologist. We remember him not only for his remarkable skill and ability as a diagnostician and for his permanent contributions in the field of radiology, but for his clear ideals which kept his work and writings on the highest plane of scientific honesty. Especially do we remember him for his kindly, sympathetic understanding and helpfulness of younger men and of those whose opportunities were limited.

Russell Carman will be remembered best, perhaps, as the years pass, for his *practical* contributions to radiological diagnosis.

With this in mind I have chosen for this address a subject of outstanding practical importance, with the hope that I may be able to present it in such a way that you will find in it suggestions which will be helpful to you and your patients in your everyday practice of radiology.

It is only within the past decade that the frequency and importance of bronchiectasis have become recognized. Until 1922, when Sicard and Forestier introduced a method by which the bronchial tree could be visualized, it was believed that bronchiectasis was a rare disease. It is now known that it is one of the most common of pulmonary diseases. Even yet, a considerable percentage of cases are wrongly diagnosed. Nearly every patient with well-marked symptoms of bronchiectasis, especially if he has had hemoptysis, will have, at one time or another, a diagnosis of tuberculosis. Many such patients have spent long or short periods in tuberculosis sanatoria even though the sputum is persistently negative for tubercle bacilli. It is true that bronchiectasis is sometimes an accompaniment of tuberculosis of the lungs but the type which is now known to be so common is non-tuberculous.

[1] The Carman Lecture, delivered before the Radiological Society of North America, at the Twenty-first Annual Meeting, at Detroit, Dec. 3, 1935.

ETIOLOGY AND PATHOLOGIC HISTORY

Before we discuss the diagnosis and treatment of the disease, it is important to review briefly our knowledge of its etiology and the pathologic changes produced by it.

In the little over a century which has elapsed since Laënnec first described bronchiectasis, many causes have been assigned to the disease. It is now recognized, however, that the majority of cases are due primarily to infections. An inflammation of the bronchi precedes bronchial dilatation in nearly all cases. The disease often follows the acute infections, especially influenza, measles, and whooping cough. Infection of the paranasal sinuses has only recently been recognized as a very common accompaniment, if not a cause, of bronchiectasis. Obstruction to a bronchus by a foreign body, a newgrowth, or by pressure is often followed by bronchiectasis, but even in such cases it seems likely that infection in a poorly aërated or atelectatic area of lung is the really determining cause of the bronchial dilatation. There are rare cases of bronchiectasis in the fetus and in the new-born which result from developmental cystic changes, but they differ considerably from the clinical entity which we recognize as bronchiectasis. William E. Anspach has shown that even when bronchiectasis occurs in early infancy it is invariably preceded by an infection and in most cases by atelectasis.

The early pathologic changes are those of inflammation of the mucous membrane. The mucosa becomes hypertrophic and in the areas of hypertrophy papillomatous growths may occur, which are very vascular. The inflammatory infiltration extends

to the entire wall of the bronchus and finally results in peribronchial infiltration and sclerosis. During this hypertrophic stage of the inflammation there is much purulent secretion and sometimes ulceration of the mucosa from which hemorrhage may occur. If the disease is arrested at this point, there is evidence that the bronchial tree may be restored to normal without permanent dilatations. If the disease proceeds to the stage of atrophy, not only of the mucous membrane but of the musculature and elastic fibers, as it often does, there is no hope that the diseased bronchi can be restored. The most common cause of the dilatation of the bronchi is the weakening of the walls through destruction of the muscular and elastic fibers; secondary causes are the increased intrabronchial pressure due to obstruction and coughing, removal of the normal support of the bronchi by inflammatory changes in the surrounding lung structure, and the traction due to the fibrous changes produced. The disease occurs much more frequently in the lower lobes than in the upper, and considerably more often in the left lung than in the right.

SYMPTOMS AND SIGNS

The diagnosis of bronchiectasis, before bronchography was devised, rested upon a few classical signs and symptoms which are present only in late stages of the disease and are of no value for early diagnosis. If the patient gives a history of paroxysmal coughing attacks when he expectorates large quantities of foul-smelling sputum, the diagnosis of bronchiectasis is usually justified. Such cases must, of course, be carefully studied in order to arrive at a correct picture of the location and extent of the disease; to determine the presence of complications and to differentiate it from abscess of the lung and other chronic suppurative conditions. A not uncommon accompaniment of long-standing bronchiectasis is pulmonary osteo-arthropathy, the most marked sign of which is clubbing of the fingers.

The symptoms which will lead one to suspect the presence of bronchiectasis in its *early* stages are readily overlooked. The only symptom complained of may be a persistent and somewhat annoying cough, with the production of only a small amount of mucoid sputum or of no sputum at all. When such a patient finds the cough annoying enough to consult a doctor he should not be put off with a casual examination or the prescription of an expectorant. There are usually no physical signs of any value whatever in such patients. Another symptom, which in some cases is the only one present, is hemoptysis. There may be a history of blood-tinged sputum extending over a period of several years, rarely of severe hemorrhages. Such patients are fortunate if they escape a diagnosis of pulmonary tuberculosis and months or years in a sanatorium. This question of hemoptysis in bronchiectasis requires great emphasis. Tuberculosis must be diagnosed in cases of hemoptysis only when there is positive evidence of its presence entirely aside from the hemorrhage.

Ochsner writes of the early diagnosis of bronchiectasis as follows: "Hemoptysis is a frequently encountered symptom, being present in from 50 to 70 per cent of cases. Seldom is bleeding severe; very frequently, however, a tinging of the sputum with blood is noted. Clubbing of the fingers is present only in advanced cases and those in which the condition has existed for a long period of time. Except in advanced cases, the patient feels well, aside from some slight lassitude. They often complain of not having the amount of energy which they usually have, although they are able to perform their work comparatively well. Because of rather vague, indefinite symptoms, these individuals are often branded as neurotics." (The article of Ochsner from which the above is a quotation is a very complete consideration of bronchiectasis and is followed by an exhaustive list of references to articles on the subject. It will be found in "The American Journal of the Medical Sciences," Vol. 179, 1930.)

I have tried to emphasize the fact that the radiologist must always be keenly alert

to recognize the possibility of the presence of bronchiectasis from very mild and seemingly inconsequential symptoms. The only clue to the cause of a persistent cough may be found in the history of an infection which the patient remembers only after questioning. The presence of chronic nasal sinus disease should direct one's attention to the possibility of an accompanying bronchiectasis. A not uncommon history is of recurring attacks of fever. The disease not infrequently produces inflammatory changes in the surrounding lung and the patient may say that he has had several attacks of pneumonia or pleurisy. The roentgenologist has an especial responsibility in these cases because nearly all of them have a roentgen examination sooner or later. Early or even moderately advanced cases are not likely to show any recognizable changes on the roentgenogram. This is particularly true if the disease is located in the bronchioles behind the heart. A negative report should not be made until every means of diagnosis is exhausted.

When the disease is once suspected we have means by which a definite diagnosis may be made. In advanced cases with multiple dilatations and peribronchial thickening a simple x-ray examination with good films will serve to establish the diagnosis. It was not, however, until 1922, when Sicard and Forestier introduced lipiodol, that diagnosis in early cases became exact. "Lipiodol is a compound of iodine and poppy seed oil, containing 40 per cent of iodine by weight." It is a true chemical compound obtained by utilizing the ability of an unsaturated fat to fix iodine to its molecules. Typical unsaturated oils are essentially the glycerides of stearic, oleic, palmitic, and linolic acids. Some other compounds containing chlorine as well as iodine are in common use. Iodipin, a German preparation, is one of these, and iodochlorol and ariodol, made in this country, are others. The method is absolutely necessary for diagnosis of the early cases and even in advanced cases it serves to clear up the extent and exact location of the disease and offers great assistance in differential diagnosis. It is especially important to make a diagnosis in the early stages of bronchiectasis, and for this purpose bronchography is invaluable. The method has come into common use only slowly because of the supposed difficulties of administration of the oil. As long as it was considered necessary to inject the oil through a bronchoscope the method was used in only a small percentage of cases. Since the supraglottic or "passive method" of injection has become popular, bronchography has become much more widely used. This method requires no special skill and causes the patient little or no discomfort. Its complete success requires the confidence and co-operation of the patient and the anesthetization of the anterior pillars of the fauces, the vestibule of the larynx and the tracheo-bronchial mucosa. This is obtained by the use of a 2 per cent spray of cocaine while the patient inhales deeply and the tongue is held drawn forward from the mouth. The best results are obtained if the spraying is carried out at five-minute intervals for a period of half an hour. We have never had any reactions from the cocaine by this method and the results are undoubtedly more satisfactory than anesthetization secured by stronger solutions over a shorter period. The anesthetization accomplishes several objects. The first is to abolish sensation in the throat so that injection may be made without gagging; the second is to abolish the swallowing reflex which normally causes the larynx to ascend and automatically close the laryngeal opening; the third is to abolish the cough reflex so that the lipiodol will remain in the tracheo-bronchial tree instead of being forced out into the alveoli. All of these objects are accomplished by the method of anesthetization described. When anesthetization is complete the patient stands on the step of a fluoroscope and the lipiodol, slightly warmed, is dropped on the base of the tongue very slowly by means of a syringe and curved cannula while the tongue is drawn forward by the patient or the operator and the patient breathes deeply.

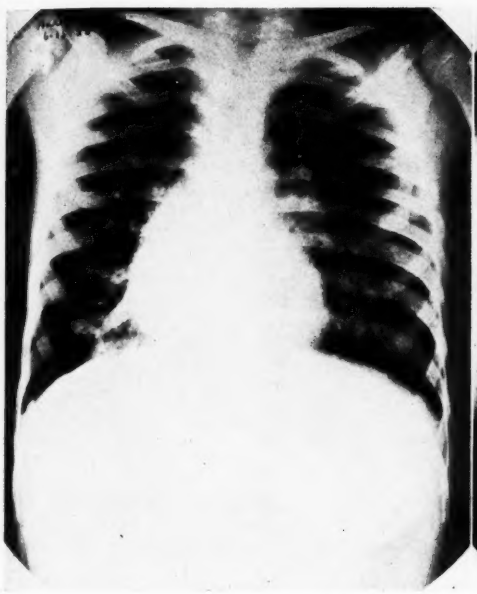

Fig. 1.

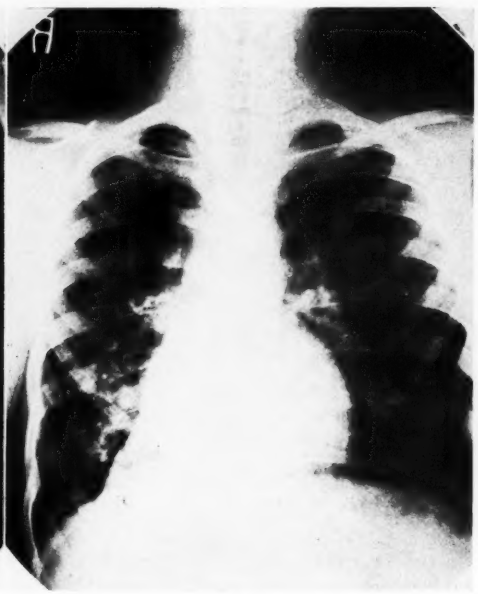

Fig. 2.

Fig. 1. Case 1. A common type of bronchiectasis in children. Note the triangular shadow in the cardiophrenic angle at the right base which represents the atelectatic lower lobe.

Fig. 2. Case 1. Three years later than Figure 1. Atelectasis still present and discrete areas of increased density indicate development of bronchiectasis in the middle lobe.

About 10 c.c. of the lipiodol is used for any particular part of the tracheo-bronchial tree. Larger amounts have been recommended in the past but by using more than 10 c.c. the alveoli may be filled and the dilatations in the bronchi obscured or obliterated on the roentgenogram. The essential points in this method are as follows: (1) The patient must be tranquil and co-operative; (2) the anesthesia must be sufficient to prevent swallowing and coughing; (3) the injection must be done slowly; (4) the tongue must be held drawn forward from the mouth while the lipiodol runs into the larynx. While the lipiodol is entering the bronchial tree the operator observes it on the fluoroscope, the patient being inclined toward the side that it is intended to fill. By rotating the patient to prevent deception from superimposition of the shadows of the radiating bronchi the bronchiectatic dilatations may be directly observed upon the fluoroscopic screen. This method is most applicable to the lower lobes but filling of the upper lobe bronchi may be obtained by tilting the fluoroscope so that the patient's head is lower than the pelvis, after the lipiodol has entered the main bronchus. This "passive method" is applicable in nearly all cases but occasionally there is difficulty in securing the entry of the lipiodol into the larynx. In such cases the intratracheal method is used. This differs from the "passive method" only in the actual injection. Anesthesia is carried out as before, but the injection is made through a long curved cannula between the vocal cords under direct observation in a laryngeal mirror. Some have used a catheter passed through the nose and into the larynx and by observation on the fluoroscope are able to direct the lipiodol to any desired part of the bronchial tree.

I have considered the method somewhat in detail because the diagnosis—and to some extent the treatment—of bronchiectasis depends upon the success of bronchography. I think it important that the

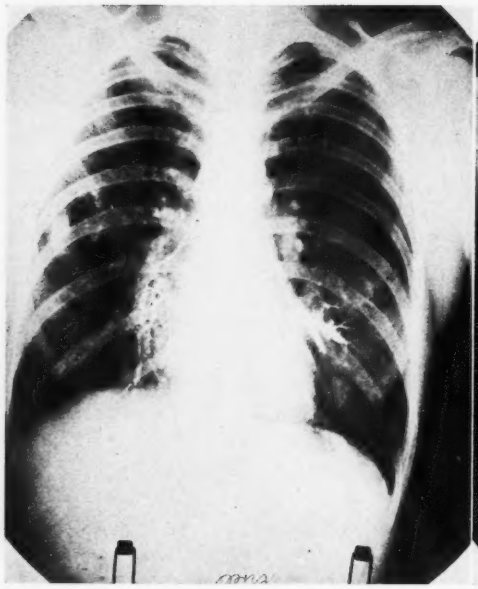

Fig. 3.

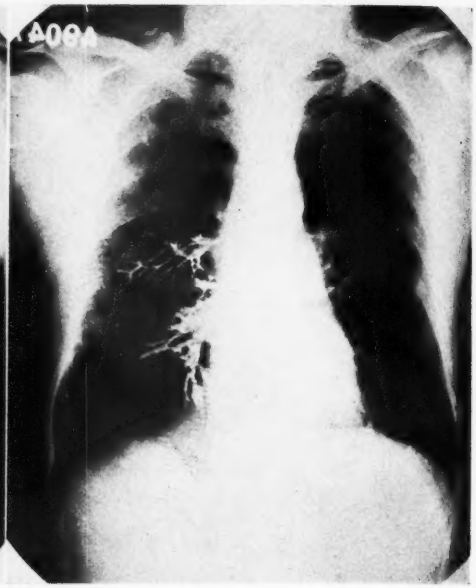

Fig. 4.

Fig. 3. Case 2. Patient whose only symptom was hemoptysis. Bronchiectasis in the left lower lobe bronchi

Fig. 4. Case 3. Patient with long-standing diagnosis of pulmonary tuberculosis. Bronchography shows greatly dilated bronchial trunks in the lower lobe, right side, and obstructive emphysema at both bases. No evidence of tuberculosis.

radiologist should understand that the responsibility for a correct early diagnosis depends upon him. It is his duty to educate the profession as to the frequency of the disease and its importance as a cause of disability and death.

Another method must be used in children and in patients who cannot cooperate. Injection of the lipiodol through the cricothyroid membrane is then the method of choice. It is known as the subglottic or transcutaneous method. To carry it out the skin is anesthetized and the needle is pushed directly through the skin and cricothyroid membrane into the trachea. Four or 5 c.c. of a 4 per cent solution of novocaine are then injected into the trachea and in a few minutes the reflexes are abolished so that the lipiodol may be injected. We have used this method in a considerable number of patients but there are objections to its use as a routine measure. Whenever practicable we prefer the "passive method" previously described, and even in children injection usually can be made by inserting a catheter through the nose.

The bronchographic findings in bronchiectasis are striking and conclusive. The dilatations of the bronchi, usually cylindrical or fusiform in shape, are unmistakably shown. Only recently the method has served to clear up the nature of certain triangular basal shadows. These shadows are seen occupying the angle formed by the heart and diaphragm on either side. Singer and Graham, in 1926, identified them as areas of atelectatic lung. It is now well established that this triangular basal shadow usually represents an entire lower lobe which is atelectatic and within which there are bronchiectatic dilatations.

Many of the important points in diagnosis are illustrated by the following brief summaries of histories and the illustrations to which references are made.

Figure 1 illustrates a common type of bronchiectasis in children. I have referred

to the triangular shadow in the cardiophrenic angle which is well shown in this case. Three years later, as shown in Figure 2, the atelectasis is still present and there are areas of increased density in the non-atelectatic middle lobe due to development of bronchiectasis in that lobe also. Brunn and Faulkner have called attention to the importance of what they term "internal drainage" in suppurative disease of the lungs. For instance, in bronchiectasis of the middle lobe the secretions spill over into the lower lobe. When the lower lobe on the left side is involved the secretions drain into the upper lobe on that side whenever the patient lies on the affected side, but if he lies on the right side the secretions drain across into the right bronchial tubes. The symptoms and physical signs of disease are often referred to the area into which drainage is taking place instead of to the areas actually diseased.

Figure 3 illustrates the case of a young woman whose principal symptom was recurring hemoptysis, sometimes of considerable quantities, over a period of five years. She complained also of nocturnal coughing attacks, with expectoration of small quantities of yellow sputum. Repeated examinations had failed to reveal any disease of the lungs. The roentgen appearance showed entire absence of any infiltrative lesion in the lungs but the lipiodol injection showed the presence of the cylindrical type of bronchiectasis in the left lower lobe bronchi.

Figures 4 and 5 are those of a patient with a very typical history of bronchiectasis. He was a white male, aged 38 years, who had had influenzal pneumonia in 1918 and has had cough and profuse expectoration ever since. He is drawing compensation from the government for pulmonary tuberculosis but tubercle bacilli have never been found in his sputum. He has a slight daily rise of temperature and is spitting up about six ounces of foul-smelling sputum every twenty-four hours. The roentgen picture shows no evidence of pulmonary tuberculosis. Bronchography (Figs. 4 and 5) shows the greatly dilated bronchial trunks in the lower lobe, right side, and the presence of obstructive emphysema at the base.

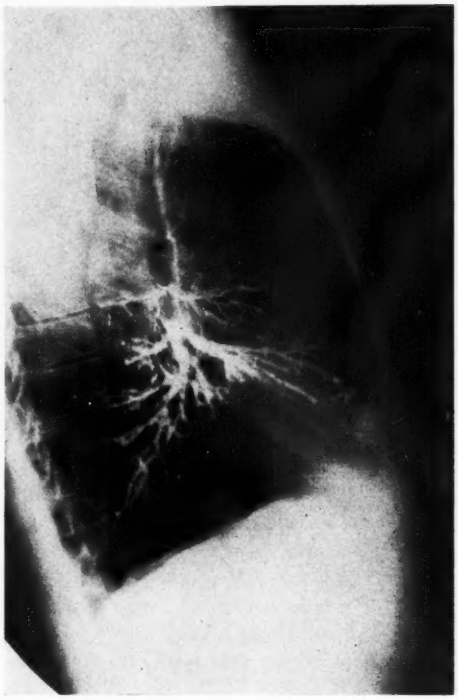

Fig. 5. Case 3. Lateral view.

Figures 6 and 7 are those of a man, aged 53, whose only symptom is hemoptysis. About twelve years ago he spit up a little blood, but, aside from a slight hacking cough, he has had no sickness of any kind until about two months ago, when he again had hemoptysis. This has continued almost every day for the past two months. The blood wells up in his throat and he spits up a considerable quantity at a time. On examination the blood is seen to be mixed with yellow pus. Lipiodol injection demonstrates the presence of bronchiectasis in the right lower lobe (Figs. 6 and 7).

TREATMENT

The treatment of bronchiectasis has never been very satisfactory, but some notable advances have been made in the past few years.

It is important, first, to clear up any disease of the paranasal sinuses. Cases have

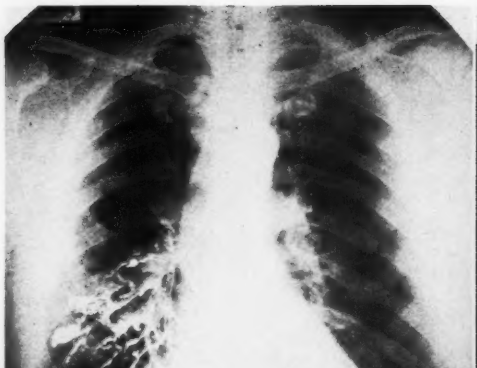

Fig. 6.

Fig. 7.

Fig. 6. Case 4. Patient, 58 years of age, whose only symptom is hemoptysis over a period of two months. Bronchiectasis in the right lower lobe.
Fig. 7. Case 4. Lateral view.

been reported in which all manifestations of bronchiectasis have disappeared when sinus disease has been cured.

If the cause of bronchiectasis is a foreign body, that must, of course, be removed; such removal has resulted, in numerous cases, in complete relief of the suppurative condition in the bronchi.

There are certain unilateral cases which may be greatly improved by repeated production of artificial pneumothorax. If collapse is not well maintained by pneumothorax, better results are sometimes secured by phrenicectomy. More radical surgery has made great advance within the past few years. When the disease is unilateral—and especially if it is confined to one lobe—it is possible to completely eradicate it by pneumectomy or lobectomy. It must be remembered that the mortality is still high in radical pulmonary surgery and operation is to be recommended only in the most carefully selected cases.

When, because of bilateral or widespread involvement, surgery is deemed inadvisable, there is still much that can be done to alleviate symptoms and lessen the disability. The great majority of these cases will remain as problems for the medical practitioner and, since the disease is an exceedingly common one from infancy to old age, he should be thoroughly familiar with its management. The radiologist can do much to assist in the treatment and to educate the general practitioner.

Postural drainage in suppurative disease of the lungs, including bronchiectasis, has been in use for about thirty-five years. It is a very important procedure, not only because it adds to the comfort of the patient, but because, by keeping the cavities free from secretion, it prevents the spilling over of the infected fluids to other normal parts of the lungs. Directions for postural drainage must be adapted to the individual patient. It is accomplished by having the patient lie for a certain length of time each day with the head lower than the feet. He first lies on his back, which is the best position for drainage of the right middle lobe

because of its anterior position, then on each side, and finally on his face. Some can secure good drainage by doing this for a half-hour morning and evening; others find it best to do it three times a day. Nearly all cases are improved by postural drainage and a few have been reported relieved of all symptoms by this method. Postural drainage is often assisted by the inhalation of vapor or steam from water containing compound tincture of benzoin, which assists in liquefaction of the bronchial secretions.

Bronchoscopic drainage has been used to advantage. Direct visualization enables the bronchoscopist to clear away granulations and thick inspissated secretions which block drainage. It is obviously limited in its use to those skilled in the use of the bronchoscope.

The only drug which seems to be of use for internal medication is creosote, which appears to lessen bronchial irritation and cough. Calcreose is a good preparation for the administration of creosote.

I have already described the use of lipiodol as a means of diagnosis. It was early noted by Sicard and Forestier and later by many other observers that the diagnostic use of iodized oils was, in many cases, followed by improvement in symptoms. Ochsner, whose article I have already quoted, has popularized the use of lipiodol as a therapeutic measure in bronchiectasis. We have used it in a considerable number of cases, introduced by the passive method which I have already described, and I believe that it has beneficial effects in this disease. It is not necessary to use the fluoroscope for therapeutic injections. Whether the effect is due to the slow liberation of iodine or only to a mechanical clearing out of the secretions with the oil, it is still uncertain. No dangers are to be apprehended from the use of iodized oils injected into the tracheobronchial tree. A few cases of mild iodism have been reported in instances in which the patient has swallowed large quantities of the oil, since the iodine is liberated quite rapidly when exposed to the gastro-intestinal secretions. Practically the only contraindication to the use of lipiodol, either for diagnosis or therapy, is the presence of the active parenchymatous type of tuberculosis. It is not harmful, and may be of great benefit, in the fibroid type of tuberculosis in which the symptoms are due more to secondary infection of cavities than to the tuberculous disease.

The radiologist and the general practitioner can render much greater service in the treatment of this disease than they have in the past. We must first recognize the fact that it is a very common condition and in its early stages difficult of diagnosis. We must learn to differentiate it from tuberculosis and from other chronic suppurative conditions. The diagnosis should include not only the presence of the disease but its location and extent. For treatment, reliance will be placed upon postural drainage, elimination of infections of the upper respiratory tract, and the injection of lipiodol at intervals of about one month. At the same time, calcreose should be given internally and hygienic and dietetic measures instituted to improve the patient's general condition. If the disease is unilateral, pneumothorax and, later, phrenicectomy may be used. The last resort in especially selected cases is radical surgical removal of the infected area of lung. This is the only method by which the disease may be permanently cured, but the dangers of the operation must be carefully weighed against the degree of disability produced by the disease and the danger of the disease to life in each individual patient.

ENCEPHALOGRAPHY: THE VALUE OF THE SECOND-DAY EXAMINATION

By EUGENE P. PENDERGRASS, M.D., *and* PHILIP J. HODES, M.D., *Philadelphia*

From the Department of Radiology, Hospital of the University of Pennsylvania

THE following cases are reported because they illustrate the value of the second-day examination in encephalography.

Case 1. L. W., white female, 11 years of age, was admitted to the Neurosurgical Service of Dr. C. H. Frazier, of the University of Pennsylvania Hospital, on April 3, 1935, because of convulsions. The history of the present illness dates back to the third week of the child's life, when the mother noticed that the child's right hand was constantly closed in a tight fist. At that time it was obvious that the baby's right arm was weak. When the child began to walk at the age of two, the parents noticed that the right leg was weak, but after a rigid therapeutic régime both these physical defects were considerably improved.

With the exception of these defects the child remained perfectly well until January, 1935, when, following a severe upper respiratory infection, she had her first convulsion. The attack came on suddenly and was characterized by jerky movements in the right arm and right leg, which soon spread over the entire body and resulted in a generalized rigid state. The rigidity lasted less than one minute during which time the patient remained perfectly conscious. The patient was given various drugs in an effort to bring about permanent improvement but, in spite of the treatment, the convulsions continued until the time of her admission into the hospital.

The family history was irrelevant. The only important feature in the child's past medical history was a middle ear infection when she was eight years of age, which followed chicken pox.

The physical examination revealed a well-developed white girl who seemed unusually irritable. She was apprehensive and nervous, and because of this condition her co-operation throughout the examination was rather unsatisfactory. The heart and lungs were negative. The right arm was held in a semiflexed position with the fingers in the position of a "claw hand." The muscles of the arm and hand were spastic. The right arm and leg were smaller than the normal extremities on the left side. The mental examination was negative. The patient was perfectly conscious and oriented in all spheres. The cranial nerves were negative with the exception of involvement of the sixth nerve in the right eye. The reflexes in the right upper and lower extremities were increased. The visual fields revealed 6/9 vision in the left eye and 6/30 vision in the right eye. The blind spot in each eye was enlarged, with a well-demonstrated contraction present in each visual field. The blood, urine, and spinal fluid examinations were negative. Clinically, the patient was thought to have peripheral manifestations of a birth injury to the head.

On Feb. 19, 1935, a roentgen examination of the head revealed: "A slight increase in the prominence of the digital markings, with some areas of increased density posterior to the dorsum sellæ near the mid-line but slightly more to the left. In addition, there was a shadow in the nasal pharynx suggesting the possibility of a soft tissue lesion, probably due to hypertrophied adenoid tissue. The pituitary fossa was top normal in size, measuring anteroposterior 9.5 mm. and depth 9 mm."

"*Diagnosis.*—Possible calcified lesion in the middle fossa of uncertain identity."

On April 5, 1935, under vinesthene anesthesia, an encephalogram (Fig. 1) was made, at which time 87 c.c. of spinal fluid was withdrawn and 82 c.c. of air injected. The report read as follows:

"The encephalographic examination is not entirely satisfactory. The subarach-

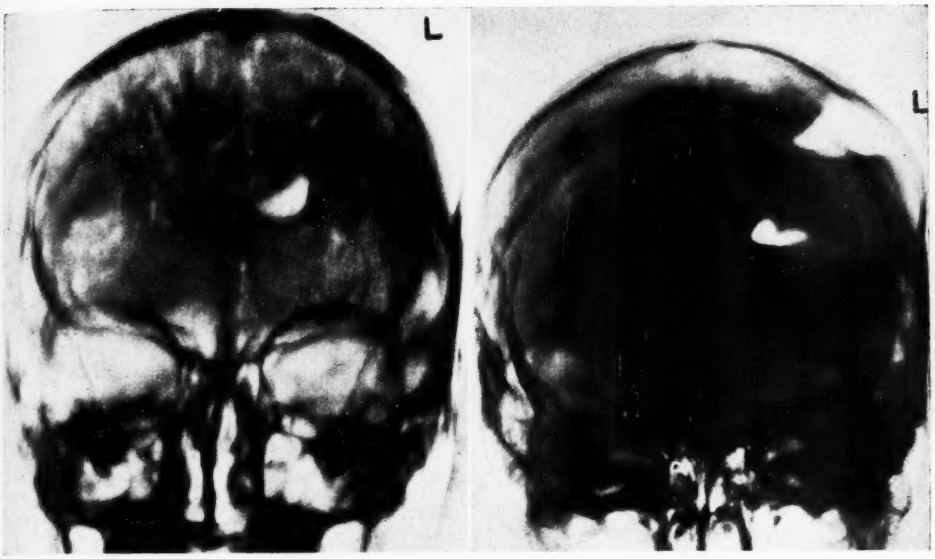

Fig. 1. Fig. 2.

Fig. 1. Case 1. Examination made immediately after air injection, showing air in the left lateral ventricle with no air on the right side.

Fig. 2. Case 1. Same patient as shown in Figure 1. Examination made 24 hours after the original air injection with the patient in the erect position, showing the air previously seen in the left lateral ventricle, and a large collection of air above and to the left of the ventricle in the porencephaly.

noid markings on the right side are increased in prominence in comparison with those over the left cerebral cortex, with a suggestion of *hemiatrophy* of the left side of the brain as compared with the right side. The evidence in favor of this diagnosis is a slight displacement of the mid-line structures to the left, and a slight elevation of the petrous portion of the temporal bone. The island of Reil is larger on the right side than it is on the left. We recommend re-examination of the patient to-morrow in order to determine whether or not air will enter the right ventricle, since at the present time only the left ventricle is visualized."

"*Diagnosis.*—Probable left-sided hemiatrophy."

On April 6, 1935, a re-examination (Figs. 2 and 3) revealed a large porencephaly in the left parietal region. "The porencephaly is large, and it is difficult to understand why we could not demonstrate it at the time of the first examination.

"*Diagnosis.*—Porencephaly, with hemiatrophy of the left half of the brain."

The patient was operated upon by Dr. C. H. Frazier, on April 7, 1935, at which time the flap was reflected in the region of the left Rolandic fissure and a large porencephaly was found. Since the operation the patient has been considerably improved.

COMMENT ON CASE 1

Failure of visualization of one ventricle is not a rarity in encephalography. When it does occur, in the absence of a mass lesion, we feel it is the result of an error in technic or a developmental anomaly. Probably some of these unsatisfactory examinations may be attributed to the choroid plexus, which may block the foramen of Monro and prevent drainage of the lateral ventricles. Because of these chances for error we have been in the habit of re-examining every patient with poor ventricular filling 24 hours after the original air injection. As a rule the 24-hour examination yields little additional information. In the occasional case, however, it is of inesti-

Fig. 3.

Fig. 4.

Fig. 3. Case 1. Same case as shown in Figures 1 and 2. Examination made 24 hours after the original injection, showing the air in the large porencephaly.

Fig. 4. Case 2. Routine postero-anterior examination of the skull, revealing marked asymmetry of the calvarium, with evidence of right-sided hemiatrophy.

mable value. This is well illustrated in Case 1; the large porencephaly would have certainly been overlooked if the patient had not been re-examined 24 hours after the first air injection.

Case 2. J. H., white male, 8 years of age, was admitted to the Neurosurgical Service of Dr. Clarence A. Patten, of the Post-graduate Hospital of the University of Pennsylvania, on May 9, 1935, because of convulsions. The history of the present illness dates back to November, 1934, when the patient suffered a severe blow in the left frontal region. Except for the local signs of injury, the patient seemed perfectly well until two months after the accident. At that time, January, 1935, the patient had his first convulsive seizure, which lasted for three hours. The attack was characterized by jerking movements of the left arm and leg, with a complete loss of consciousness. During the attack it was noticed that the patient's eyes and head deviated to the left. Following this convulsive episode, the patient developed considerable weakness in the left arm and leg. These symptoms lasted for several days following which there was a gradual return of normal function. Two months later, four months after the original injury, the patient went through a similar convulsive attack, which was characterized by the same features described previously. The attack lasted longer this time, however, and because of this the patient was brought to the hospital.

The family history was irrelevant. The patient was one of identical twins, the other child apparently being perfectly normal. There was nothing of importance in the past medical history.

The physical examination revealed a well developed child who was well oriented in all spheres. The head and eyes were deviated to the left during the entire examination. The left side of the face was weak. The left arm and leg were much weaker than the normal right arm and leg, and were considerably under-developed in comparison with the normal right side. Adiadochocinesia and apraxia were found in the left hand, and all of the reflexes on the left side of the body were markedly exaggerated.

A roentgen examination of the head (Fig. 4), made by Dr. Karl Kornblum on May 10, 1935, was interpreted by him as follows: "The pituitary fossa is normal in size and appearance. The pineal body is

Fig. 5. Case 2. Same patient immediately after air injection, revealing air in the right lateral ventricle and in the third ventricle. (Note the air outlining both islands of Reil and the callosal and singular sulci.)

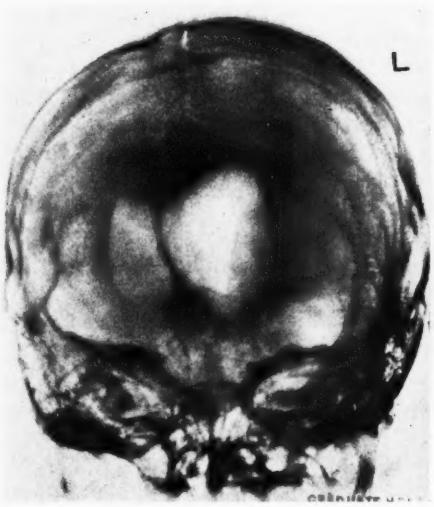

Fig. 6. Case 2. Same patient 24 hours after the original air injection, showing the left lateral ventricle, which is almost three times the size of the right lateral ventricle.

not calcified. There is no evidence of fracture of the calvarium. In the frontal projections, the right calvarium appears to be smaller than the left. The calvarium on the right side is not thicker, however, than on the left, and there is no demonstrable over-development of the sinuses and mastoids on the right side. The asymmetry between the two sides of the calvarium suggests a hemiatrophy of the right side, which might be associated with the present clinical study."

"*Diagnosis.*—Probable hemiatrophy of the right side of the skull."

An encephalogram (Fig. 5) was done on May 16, 1935, and was reported as follows: "The sagittal view shows air in the right lateral ventricle but none in the left. The right ventricle is moderately dilated. The third ventricle is visible and definitely distorted. There is some air in the subarachnoid pathways, slightly more over the right hemisphere. There is a moderate amount of air present in the island of Reil on both sides; there is also some air in the supracallosal space. The right hemisphere is distinctly smaller than the left and for this reason the right ventricle shows a distinct shift to the right. In the left lateral view there is considerable air in the inferior horn of the right lateral ventricle; the body and anterior horn are not visible. In the right lateral view there is only a faint visualization of the right lateral ventricle. The basal cisterns are normal in appearance. The fourth ventricle and aqueduct are only faintly shown; these structures are not dilated. The subarachnoid pathways which are visible are essentially normal in appearance. We are unable to account for failure to visualize the left lateral ventricle, and for this reason it seems advisable to reexamine the patient to-day, that is, 24 hours after air injection."

The examination as repeated on April 17, 1935, reveals the following (Fig. 6): "Examination to-day shows a distinctly different picture from that obtained yesterday. There is now visualization of both lateral

ventricles. Both are dilated, but the left is much larger than the right. The anterior horn of the dilated left lateral ventricle appears to be encroaching upon the smaller right lateral ventricle. There is only a small amount of air present in the third ventricle and none visible now in the subarachnoid pathways. There remains some air, however, in the basal cisterns. There is again noted the definite shift of the ventricular system to the right."

"*Conclusion.*—We are inclined to regard the abnormalities in the encephalogram as due to a congenital hemiatrophy of the right cerebral hemisphere. On this basis it is, however, difficult to account for the fact that the larger ventricle is on the side opposite the hemiatrophy. Our only explanation for this is the possibility of some distortion of the basal structures of the brain, incident to the right lateral shift, which is producing intermittent obstruction of the foramen of Monro on the left side; such obstruction would also account for the fact that no air entered the left lateral ventricle on the first day of the encephalographic examination."

COMMENT ON CASE 2

This second case is being reported through the courtesy of Dr. Karl Kornblum, of the Department of Radiology of the Graduate Hospital of the University of Pennsylvania. In this case, as in the patient previously reported, the routine roentgen examination revealed evidence of hemiatrophy. In the second patient, the first encephalogram revealed adequate filling of the right lateral ventricle but no evidence of air in the left lateral ventricle (Fig. 5). Twenty-four hours later (Fig. 6), both ventricles were well visualized, but instead of the larger ventricle being in the atrophic hemisphere it occupied the apparently normally developed side of the calvarium. The only plausible explanation for this bizarre finding was offered by Dr. Kornblum, and is included in his report made on April 17, 1935.

Technic.—We now examine all patients who have had encephalograms 24 hours after the original air injection, regardless of the degree or adequacy of ventricular filling at the time of the first examination. In patients with incomplete ventricular filling, they are made to lie with the inadequately filled ventricle uppermost, in order to promote drainage and ventricular filling. The 24-hour examination is made with the patient in the erect position, and we limit our examination to one lateral and an anteroposterior or postero-anterior film. We have seen no reactions in the patients in whom this procedure has been carried out.

Discussion.—It is still too early to analyze our findings in the examinations made 24 hours after the original air injection. The fact that both cases reported in this discussion were encountered within two months of one another makes us feel that we are not reporting a unique state of affairs. We believe, therefore, that the 24-hour examination is of inestimable value in all patients showing incomplete ventricular filling after the original examination.

NASOPALATINE DUCT CYSTS

By MOSES GOODMAN, B.S., M.D., *Brooklyn, N. Y.*
Assistant Radiologist, Jewish and Israel-Zion Hospitals, Brooklyn

NASOPALATINE duct cysts are cysts which form in the incisor canal region of the maxilla and originate in the nasopalatine duct, or its remnants; these cysts have no direct relationship to the teeth, but, in their growth, may encroach upon the incisor apices. Although occasionally observed in radiographic examinations of the incisor area of the maxilla, nasopalatine duct cysts were often erroneously interpreted as dental cysts, or as enlarged incisor foramina; they have also been erroneously considered as supernumerary paranasal sinuses. They were, therefore, formerly believed to be very rare, but, with proper diagnosis, will be discovered more frequently than heretofore.

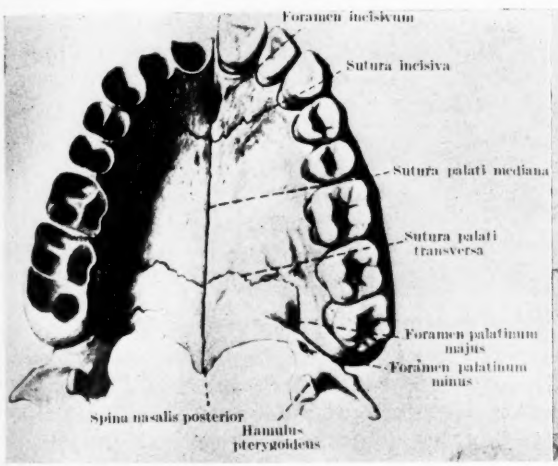

Fig. 1. Nasopalatine (anterior palatine or incisor) canal. (*From Sicher-Tandler: Anatomie für Zahnartz.*)

Fig. 2. Papilla palatina and rugæ of hard palate.

REGIONAL ANATOMY

There is a slight depression in the floor of each nasal fossa, about two centimeters posterior to the inner margin of the nostril, and in juxtaposition to the nasal septum. This depression leads into a small canal, the nasopalatine or incisor canal, the lining mucosa of which is continuous with that of the inferior nasal meatus. The canal of each side courses forward obliquely, converging toward the nasal septum, and then descends in a vertical direction to pass through the Y-shaped incisor foramen or anterior palatine canal in the hard palate. The canal terminates in the roof of the mouth at the papilla palatina (Figs. 1 and 2). According to Piersol (1), these canals usually remain independent, although they may join to form a single incisive canal. They are closed and impervious, but occasionally communication is retained between the nasal and oral cavities. There is a slight protuberance, about two by four millimeters, on the mucous membrane of the hard palate at the median line, just posterior to the central incisor teeth, which is called the papilla palatina, and covers the mouth of the incisor canal; the rugæ of the palate are situated on either side of this papilla (Fig. 2). Although the fusion of the

Fig. 3. Photomicrograph of section through the jaw, showing nasopalatine duct cyst, the wall of which is lined with epithelium.

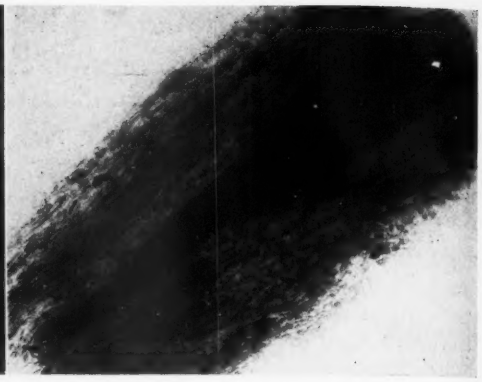

Fig. 4. Photomicrograph (high power), showing epithelial cell rest in fibrous wall of cyst.

Fig. 5. Photograph of cast, showing swelling of papilla palatina.

palatine processes of the maxillæ divides the oral from the nasal cavity, a communication between these cavities exists in early fetal life anteriorly through the nasopalatine ducts. However, in the great majority of cases, these ducts become obliterated and remain as impervious cords of epithelial cells, continuous with the epithelium of the hard palate at one end, and with the ciliated epithelium of the nasal fossa at the other. Rawengel (2), in his embryologic studies, revealed three sets of epithelial tissues in the anterior maxillary region: first, that of the nasopalatine duct and its cell rests; second, a middle epithelial cord in the common incisor canal, and third, epithelial cells found in the most posterior part of the papilla. In the majority of cases, all of the epithelial cell rests, with the exception of those of the nasopalatine duct, disappear in the first year of life. He claims that a blind sac, either from the nasal or buccal cavity, may exist, or, if the duct is obliterated at both ends, its central part may become cystic.

ETIOLOGY AND PATHOLOGY

Dental cysts are usually classified as of three types: (1) root cysts; (2) follicular or dentigerous cysts, and (3) multilocular cysts, or adamantinoma polycysticum, which are considered by some as tumors with cystic changes. The root cyst is the result of an infectious process in a tooth which involves the pulp and forms a "granuloma" at the apex; in many cases, these granulomas develop into cysts, when epithelial cell rests are present in the peri-

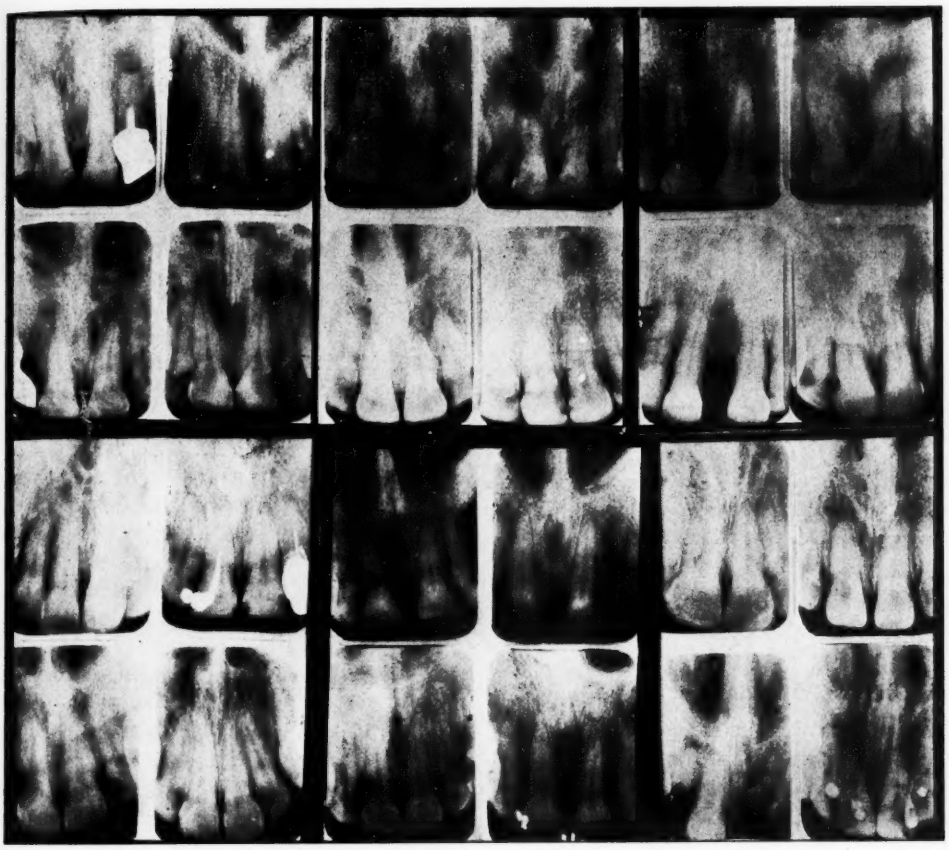

Fig. 6. Variations in radiographic appearance of the bone in the upper incisor region.

dental membrane of the tooth. The follicular or dentigerous cyst results from an infection of the dental follicle of developing tooth germs of the permanent teeth, and not from an infection of the tooth or its peridental membrane. It may arise from a supernumerary tooth, and therefore such cysts may occur outside of the alveolar process of the maxilla, and have been found in the maxillary sinus and in the palatine bone. The multilocular cyst usually occurs as the result of cystic degeneration of a tumor, which originated from a dormant epithelial cell rest, when the latter began to proliferate; this may occur as a result of trauma or of infection. However, multilocular cysts occur most often in the mandible.

According to Schroff (3), nasopalatine duct cysts may result from: (1) intra-oral trauma to the papilla palatina, with resultant inflammatory reaction extending upward into the nasopalatine canal; (2) from a dental origin, due to an apical infection of the central incisor teeth which extends to this canal, and (3) from a nasal origin, secondary to an infection of the nasal mucosa, with extension of the infectious process down into the canal. Regardless of the origin, permanent occlusion of the lumen of a persistent nasopalatine duct or blind sac may occur as a result of an inflammatory process in the nasopalatine canal, and then the accumulating secretions cause the formation of a cyst. Or, the pathologic process may activate epithelial cell rests in the incisor canal, and these rests may then undergo cystic degeneration. A cyst may also result from the occlusion of some mucous glands within the incisor

canal. Nasopalatine duct cysts may be formed with a cavity wall which is lined with squamous epithelium (Fig. 3), or with

Fig. 7. Small dental stereoscope.

a wall of fibrous tissue which contains epithelial cell rests (Fig. 4).

SYMPTOMATOLOGY

From the clinical standpoint, it must be remembered that nasopalatine duct cysts usually have an insidious onset, without producing any symptoms; they are then discovered in routine examinations of the teeth. When small, they may be overlooked, or considered as enlarged incisor foramina. However, when an inflammatory reaction occurs, or when the cyst expands sufficiently to encroach upon the surrounding bone, sensations of fullness or pressure in the incisor area occur. Nasopalatine duct cysts may give rise to definite pains, which are usually of a neuralgic character, and may radiate to the nose or to the eyes; in some cases, these pains radiate along the roof of the mouth. Swelling of the papilla palatina (Fig. 5) may occur, or a history of such may be obtained. Tenderness is often elicited upon pressure or percussion over the anterior incisor region.

ROENTGENOLOGY

Normally, the radiographic appearance of the bone in the upper central incisor region presents wide variation (Fig. 6). In some cases, there is no evidence of an incisor foramen; in others, the latter may be only faintly visible. When present, this foramen may be of oval or rounded contour, small or large, and the osseous structure about same of varying density. With formation of the cyst, a circumscribed area of decalcification results, which increases in its size as the cyst grows. Nasopalatine duct cysts are usually symmetrically situated in relationship to the mid-line of the upper incisor area, but may also be unilateral. In the latter instance, a routine lingual study, radiographically, of the incisor region may give a false impression of the cyst being bilateral. This is evidently due to the anatomic character of the region, the vault and curve of the dental arch causing difficulty in the proper projection of the image. The routine radiographic study may also mislead the observer as to the involvement of the apices of the adjacent incisor teeth by the cyst. This limitation of the radiographic interpretation can be overcome by careful studies of the region by both lingual and occlusal views, and especially, by stereoscopic studies. The latter should be done with the occlusal projections, thus obtaining the three dimension relationship of the area. Such stereoscopic examinations are seldom made by the roentgenologist, but, because of the valuable information obtained, should not be omitted. To obtain good stereoscopic radiographs, the patient's head must be properly immobilized, employing the technic of demarcating the occlusal film containers for placement by outlining the bite contour of the incisor teeth thereon, or by placing the occlusal films in a slide holder which is held in position by the closed mouth during the exposures. Viewing of these stereoscopic radiographs is possible directly through the small dental stereoscope (Fig. 7), or by enlarging the films and using the regular roentgenologist's stereoscope (Figs. 8 and 9). Nasopalatine duct cysts are usually above and posterior to the apices of the incisor teeth, and stereoscopic studies will therefore differentiate them from root cysts. A similar differential

diagnosis from aberrant paranasal sinuses can also be made. The roentgenologist's report of the relationship of such cysts to the apices of the incisor teeth is of much importance to the oral or dental surgeon, and is well worth the additional technical work in obtaining the stereoscopic radiographs.

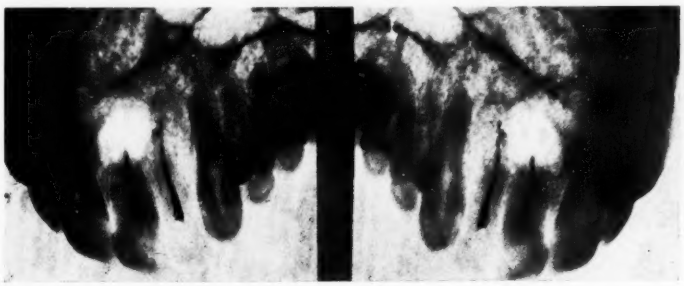

Fig. 8. Occlusal stereoscopic studies, showing nasopalatine duct cyst and root canal filling of adjacent incisors.

TREATMENT

Surgical removal and curettement of the area of the cyst is indicated when repeated swellings of the papilla palatina have occurred, or, when there is a history of neuralgic pains radiating along the roof of the mouth or nose, or to the orbital regions. Conservative treatment may be attempted in cases in which the symptoms have not been severe; when such treatment is instituted, repeated radiographic studies should be made at various intervals to determine any expansion of the cyst. If the latter is observed to grow larger, even if the symptoms are not severe, surgery is advisable. Removal of the upper incisor teeth in the involved area is rarely, if ever, necessary since nasopalatine duct cysts are not of dental origin. When, upon expansion, the cyst affects the roots of the adjacent incisor teeth and causes erosion of the same, apicoectomy can be done. In the absence of symptoms, or of any increase in size of the area of decalcification caused by the cyst, surgery is not indicated.

CASE REPORTS

Case 1. Female, aged 23 years, gave a history of recurrent swelling in the region of the papilla palatina, without pain but with a dull pressure sensation. A radiographic study of the upper incisor region revealed a sharply circumscribed area of decalcification about the incisor foramen, which did not involve the apices of the incisor teeth (Fig. 10). Operation disclosed a cyst containing a brownish, viscid fluid. A pathologic examination revealed a cyst with thin walls of fibrous tissue and a lining of squamous epithelium; the findings were significant of a nasopalatine duct cyst. Recovery was uneventful, and subsequent radiographic studies showed bone filling of the affected area.

Case 2. Female, aged 23 years, gave a history of tumefaction in the region of the papilla palatina, and neuralgic pains radiating along the nasal floor and sides of the nose. A radiographic examination revealed a rather large rarefied area at the incisor foramen, which did not encroach upon the apices of the adjacent incisor teeth, although a lingual study gave such an impression (Fig. 11). Operative and pathologic findings disclosed a nasopalatine duct cyst, the walls of which contained epithelial cell rests and some mucous glands.

Case 3. Male, aged 30 years, gave a history of repeated swellings and tenderness in the region of the papilla, and neuralgic pains radiating from the roof of the mouth to the frontal sinus region. A radiographic study revealed an area of decalcification in the incisor foramen region, which did not involve the apices of the adjacent incisor teeth (Fig. 12). The cyst proved to be of nasopalatine duct origin.

Case 4. Male, aged 31 years, gave a his-

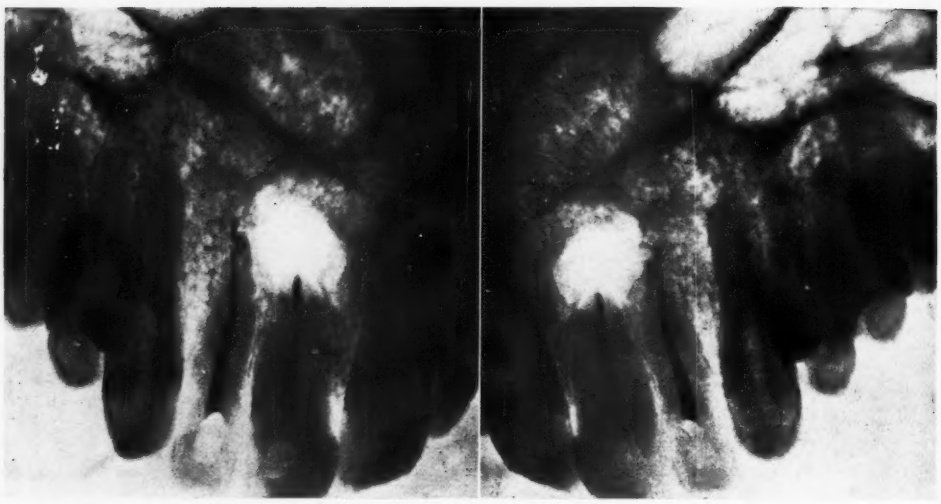

Fig. 9. Enlargements of occlusal stereoscopic radiographs for viewing with regular stereoscope.

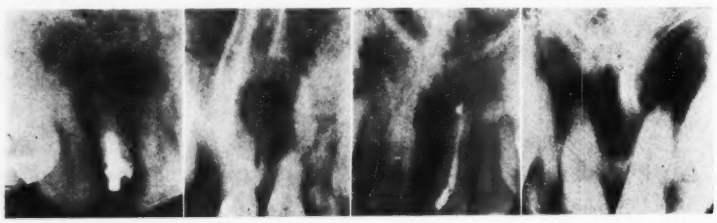

Fig. 10. Fig. 11. Fig. 12. Fig. 13.

tory of a sensation of fullness and dull pains in the upper incisor region and nasal floor; slight tenderness could be elicited upon pressure over the upper lip. A routine lingual radiographic examination revealed a large area of decalcification in the upper incisor region, which appeared to involve the apices of the central and lateral incisor teeth (Fig. 13). Further studies, however, showed this cystic area to be posterior and above these apices, and to extend mainly along the right side, although the lingual study also gave the impression of a marked left side involvement. In view of these findings, and as the incisor teeth were vital, it was not necessary to do an apicoectomy in the operative procedure. A pathologic study proved the cyst to be of nasopalatine duct origin.

CONCLUSIONS

The roentgenologist should consider the possibility of the presence of a nasopalatine duct cyst whenever he observes an area of decalcification in the region of the incisor foramen. He should not rely upon the routine lingual study of the upper incisor teeth in such cases, but make special occlusal and stereoscopic examinations to properly diagnose the case, and also to determine the relationship of the apices of the adjacent incisor teeth to the cystic area. The error of diagnosing a small cyst as an enlarged incisor foramen should be avoided; when in doubt, subsequent follow-up radiographic studies may show enlargement of the area of decalcification and prove it to be a cyst. Nasopalatine duct cysts are not as rare as formerly thought, and it is advisable to interpret cystic areas in the region of the incisor foramen which have no connection with the apices of the incisor teeth, as nasopalatine duct cysts. However, in cases in which these cysts have enlarged to such ex-

tent as to encroach upon these apices, the differential diagnosis between such cysts and root or dentigerous cysts may not be possible from the radiographs alone; the history of the case may be of some aid, if repeated swelling in the region of the papilla palatina had occurred. A thorough radiographic study of cases presenting an area of decalcification in the region of the incisor foramen will be of great aid to the oral surgeon; it will also often prevent the extraction of vital and normal incisor teeth by the dental surgeon, due to the erroneous interpretation of root abscess in the routine lingual study.

In concluding, I wish to express my gratitude to my colleague, Dr. Joseph Schroff, Associate Professor of Oral Pathology, Columbia University, for his invaluable aid in our studies of this subject.

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SOME LAWSUITS I HAVE MET AND SOME OF THE LESSONS TO BE LEARNED FROM THEM[1]

(Sixth Installment)

By I. S. TROSTLER, M.D., F.A.C.R., F.A.C.P., *Chicago*

THE EARLIEST MEDICAL MALPRACTICE SUITS

WHILE we are on the subject of medical malpractice suits, it may be worth while as well as instructive to know something concerning the earliest malpractice suits about which we have information.

The earliest medical malpractice suit that a search made for the writer several years ago revealed,[2] was that of Slater *vs.* Baker and Stapleton (C.B., 2 Wilson's Reports, 359, Michaelmas Term, 8 Geo. 3, 1767). This suit occurred in England as the result of the treatment of a fracture of the tibia and fibula in the leg of the plaintiff, in which Baker, a surgeon, and Stapleton, an apothecary, were the co-defendants. The trial was held before Lord Chief Justice Wilmot and a verdict with damages in the amount of five hundred pounds was given the plaintiff.

Prior to 1767, there was apparently some difference of opinion or question regarding the existence of a cause for action for damages against a surgeon for improper treatment. Tracing the law back, before that date, it is found that such action must have been brought either as trespass (*trespass vi et armis*) or as assault, which is, of course, a criminal charge. In 1580, there is an indication of a court decision, pointing toward pecuniary damages being assessed, in the case of Mulgrave *vs.* Ogden (2 Croke Elizabeth 219), in which the general rule is laid down that in all cases in which a damage accrues to another by reason of the negligence, ignorance, or misbehavior of a person in the duty of his trade or calling, an action in the case will lie; "as if a farrier killed my horse by bad medicine or refused to shoe him or cut him in the shoeing."

The first medical malpractice suit in America found by the attorney who searched the records and literature for me, is Cross *vs.* Guthery (2 Root 90, 1 Am. Dec. 61, Feb. term, A.D. 1794, Toland County, Connecticut). This was a suit started in October, 1791, against a surgeon for damages, alleging that the said defendant had unskillfully operated on the plaintiff's wife and that a cause for action for damages was properly laid in the declaration, notwithstanding the fact that the patient died following the operation.

The defendant pleaded that shortly after the filing of this suit, the plaintiff and the defendant mutually agreed to off-set the claim for personal damages against the doctor's bill and the defendant discharged the plaintiff from the payment of the bill and that the said plaintiff had accepted the same in full satisfaction of the damages for the injury complained of in the present declaration. The jury found that it was not agreed as the defendant had alleged, and gave the plaintiff a verdict for forty pounds damages and his costs.

The defendant then moved in arrest of judgment that the declaration and matters therein contained were insufficient to render a judgment upon, for the reason that the offense charged appeared to be a felony and that, by the laws of England, the private property was merged in the public offense. The Court decided that the declaration was sufficient and that the judgment should stand.

Here, in this very early case, is shown an example of the inadvisability of acknowledging that an error has occurred. By agreeing to off-set his bill for services against the damages done the plaintiff, the

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[1] The Editor desires to state that much of the matter herein has to be printed in form as received, without normal punctuation or phrasing.

[2] I desire to hereby acknowledge my indebtedness and obligation to Mr. Paul C. Hodge, of the Chicago Bar, for invaluable services.

defendant surgeon practically acknowledged the truth and justice of the plaintiff's claim. That was over one hundred and forty years ago, and it is just as important to-day as it ever was. I have repeatedly tried to impress upon physicians that they must *never* acknowledge having committed error. Lying or misrepresentation are not necessary, but evasion or indirect replies can be made, when direct questions are asked. Again I say, *do not admit that a mistake has been made.* Silence is golden, here probably more than in any other situation connected with our work.

The next recorded medical malpractice suit was in England, entitled Sears *vs.* Prentice (8 East's Reports 347, April 27, 1807), and was an action brought by a shoemaker against a surgeon for negligently, ignorantly, and unskillfully reducing a dislocated elbow and fractured arm of the plaintiff. The trial court rendered a verdict for the defendant, by the direction of the judge. In a motion for a new trial before the same judge, the attorneys for the plaintiff insisted that there was evidence before the jury of the unskillful treatment of the plaintiff by the defendant; but the court said that unless negligence was proved, it could not examine into the want of skill, and the evidence, as stated, did not substantiate the charge of negligence though it did prove the want of skill. The court referred to the previously mentioned case of Slater *vs.* Baker (2 Wilson's Reports, 359, 1767), to show that an action lay against a surgeon for ignorance and unskillfulness in his profession, and to the Mulgrave *vs.* Ogden case (2 Croke Elizabeth 219, 1580), in which the general rule is laid down in all cases in which a damage accrues to another by the negligence, ignorance, or misbehavior of a person in the duty of his calling or trade.

On appeal of this case, the higher court stated that an action would lie against the surgeon for gross ignorance and want of skill in his profession, as well as for negligence and carelessness to the detriment of the patient; but if the evidence be of negligence only, which was properly left to the jury and negatived by them, the court would not grant a new trial because the jury was directed that want of skill alone would not sustain the action.

Here we find the first opinion and decision that "want of skill alone would not sustain an action," and here is also one of the examples of what makes the law and how and why adjudications are made, as described in the first part of the first installment of this series. These were decided according to the precedents established in 1767, and that first one by a more or less hazy case tried in 1580. Malpractice suits hinging upon these particular points are decided nowadays upon these very points, practically as they were laid down nearly two hundred years ago, and based upon a case, partially analogous, which was tried nearly four hundred years ago, *and they are rightly decided upon these particular points.*

RES ADJUDICATA AND LIMITATION EXPIRED

A very good friend of the writer in an eastern State, wrote in what appeared upon the surface to be panicky alarm, that a patient whom he had treated for a thyrotoxicosis and whom he had had to sue for his fee (and had secured a judgment which had been paid), had threatened to sue him for malpractice.

He gave me the dates of the application of his treatment and I was glad to be able to write him as follows:

"My Dear H . . : Yours of recent date to hand and I hasten to reply that you have no cause to worry about that threatened malpractice suit.

"There are two good and sufficient reasons why that suit should be thrown out of court, and I very seriously doubt if any reliable attorney would even consider filing suit, if he knew these reasons.

"These reasons are, first: The doctrine of *res adjudicata* will not permit of a suit in malpractice to be brought. An explanation of this doctrine of *res adjudicata*—which means, 'the thing has been adjudicated'—may be worth while. As applied to the medical profession, when a physician has brought suit against a patient for his

fees and a defense or counter-claim of malpractice is filed by the patient and defendant has contested the case, if now the plaintiff physician secures a judgment, the patient may not bring suit against the physician for that same case.

"This is based upon the theory and a considerable number of decisions, that all questions pertaining to the manner or character of practice have been adjudicated at the time of the trial for the physician's fee for his services, and consequently cannot be again opened between the parties to the previous suit. In some States the question of malpractice need not even be mentioned or considered during the suit or trial for the physician's fee; but the doctrine of *res adjudicata* holds just the same.

"The second reason why your threatened suit will not 'hold water' is that the limitation for the filing of such a suit has expired. That is, so long a period of time has elapsed since the date of your last treatment of this patient, that the period fixed by the statute of limitations in your State has passed when suit for malpractice may be begun.

"You, of course, know that these statutes of limitation, while limiting the time in which suits may be brought or started, do not of themselves confer any right of action. They are based upon the general experience and assumption that real or valid claims are not allowed to remain neglected and not properly attended to. It is true that suits begun after the lapse of the limit are not rare: most of these are what we term 'nuisance actions' and are seldom pressed for trial. I had one such brought against me, which, after having been postponed several times by the plaintiff, was thrown out of court because of the pleadings of my attorneys that the limitation had expired.

"Now as to how best to dispose of this threat. I would advise you to have your former patient—the one who is threatening to sue you—see you or your attorney, and at that time inform him (or her) of the foregoing and suggest that he (or she) see his lawyer about it."

My friend did exactly as I advised, and no suit was filed. When I next saw him he bought me a dinner and laughed at his fears.

A BREACH OF CONTRACT CASE

Several years ago, one of the well known and old-time roentgenologists wrote me as follows:

"Dear Tros: It appears that I am in a little trouble and need some of your, always so freely given, advice.

"I treated the wife of a very keen attorney, with what I thought to be quite satisfactory results. She had an inoperable uterine carcinoma, and while she did have a slight second degree dermatitis, which healed completely in about three weeks, I felt and now feel that they should be grateful and well satisfied.

"Nothing whatever was said about my fee until about six months after the completion of the treatment, at which time I sent them a bill for $300. I did not hear from them for about a year, but let it ride, as the lawyer was apparently quite well to do and bore a high reputation among his neighbors and associates. After a year, I sent him another bill but again received no response, and I again let the matter ride. A few months ago, thinking that it was about time I was paid, I wrote asking for payment and after waiting for a couple of months, wrote again, this time demanding settlement.

"Yesterday I received notice that suit had been filed against me by my patient, the attorney's wife, claiming damages in the amount of $20,000. It is just a little more than three years since I completed my treatment. The statute of limitations is two years in this State for what you law fellows call *torts*, and I am sure that this lawyer knows that as well as anyone, so that it is probable that they will prosecute their suit for breach of contract.

"Write me what you think of this, and oblige."

I replied: " . . . I do not think that you need lose much sleep about the suit filed against you by that lawyer's wife. It was

almost certainly started as a nuisance suit, with the idea and purpose of getting rid of your account.

"Suits of this sort have but little chance nowadays, because every one concerned knows that they are merely based upon an effort to evade the statute of limitations for torts.

"In the language of some one (a lawyer, of course), the law abhors a subterfuge. Attempts to accomplish by covert and indirect means, what cannot be accomplished or secured by direct or straight means, practically always meets with opposition from the courts, and justly so. The courts know and recognize that such a suit, filed far too late, must of itself have no real merit, or it would have been filed and commenced in time and before the lapse of the limitation of the statute. If this woman had been really damaged, that damage would have been manifest more than a year ago, and the judges sitting in our courts know that.

"A contract is pretty clearly defined by the law. The law also clearly describes the duties entailed and the limits of a contract of this kind. Because of that, charges of this kind and cases of this character are almost certain to be defeated. Courts all over this country hold that such a suit is and must be held to be an action in tort, no matter how the plaintiff or her attorney may prefer to designate it.

"That is the way I understand the situation, and I am sure that your attorney will agree that I am correct. With your good fighting insurance back of you, I am sure that you need not give that suit a moment's thought. I would, however, immediately file a counter-claim for the full amount of your fee, if your attorney will permit."

This case was set for trial several times, and each time the attorney for the plaintiff asked for continuances. At the fourth such request for a continuance, the attorney for the defendant objected and the judge directed that the trial proceed. Just before the case was called, the plaintiff's attorney offered to settle for a receipted bill, which defendant refused. Settlement was arranged by plaintiff paying three-fourths of defendant physician's fee.

The foregoing is an example of what we call a "nuisance suit," started when plaintiff knew he could not win, but thought that he might be able to evade payment. I am connected with such a case at the present time, having examined a patient whose parents are suing a physician who did as good a job as anyone possibly could, but who wants to be paid for his services.

I am sure that if we were more prompt in collecting our fees, we would have fewer suits of this sort, and much less of the grief that these nuisance suits cause us.

RELEASE (AUTHOR'S NEW FORM)

A confrère in a nearby State recently wrote me: "I have been threatened by a lawyer with suit for malpractice. I suppose you are told that more often than you care to hear it; but my case is different.

"The woman patient, whose lawyer is threatening to sue me, signed a statement releasing me from any injurious effect of my treatment before I began to treat her. She did get a burn which had to be dissected off and skin grafted over the area before it would heal.

"The last time she was treated by me was exactly seventeen months ago. Her lawyer informs me that the release signed by her is absolutely worthless and unless I make arrangements to settle with her soon, he will file suit. "Please advise me at your earliest convenience."

I wrote: "Replying to yours, will say that while your idea that your case is different may fit in with one phase of the matter, it is not so very different, because *you are not protected by the release you have, unless it is worded differently from any of the ordinary forms that I know about or are in common use.*

"Under ordinary conditions, a release from a patient, signed before operation or treatment, is considered to be against public policy. A release is a form of contract and it is against public policy to allow contracts to be entered into which relieve

liability for injuries *to be done or liable to be done due to negligence or recklessness.*

"In a New York Supreme Court decision (24 N. Y. Supp., 196), it was stated that 'the principle is that parties cannot contract that they themselves may, with impunity be guilty of wilful misconduct or of that degree of recklessness which is its equivalent.'

"There is a form of release which I first recommended in 1932, and which I have used and recommended since that time, which I have been informed by some pretty good lawyers will hold water.

"My release is based upon a request and authorization by the patient for me to depart from usual and customary methods and directing me to use unusual and uncustomary methods in the treatment of the patient signing the release.

"It is well known that we must apply and use usual and customary methods in the practice of medicine, and that if, as, or when we depart from the usual and customary methods and any harm or injury results from such departure, we are liable for damages.

"Believing that there should be some way whereby we would be able to be released from a responsibility which the patients should assume, I drew the following form, and, as above stated, several pretty good lawyers say that it will stand law. The form is as follows:

"'Realizing and believing that I am afflicted with an illness which, if treated by the usual and customary methods, will almost surely destroy my life, I hereby request, authorize, order, and direct Dr. I. S. Trostler to use such unusual, uncustomary, and extreme methods in the treatment of my illness as he may deem advisable or necessary.

"'In consideration of the foregoing, I hereby agree to hold the aforenamed Dr. I. S. Trostler free, blameless, and innocent of any injury or damage which might come to me, as the direct, indirect, mediate, immediate, or remote result or sequel of such treatment by unusual, uncustomary, or extreme methods.

"'Signed this.....day of..... 193.. in the city of Chicago, County of Cook and State of Illinois.

.....

"'The above is signed with the consent and knowledge of the undersigned..... of the signer.

.....

"'Signed in the presence of

.....

"The second signature is for the wife or husband, as the case may be, and constitutes additional protection.

"You will note that the wording *requests, authorizes, and directs, etc.* If, now, I failed to do as *authorized, requested, and directed,* I would still be innocent of malpractice, because the matter is left to whether I *'deem advisable or necessary.'*

"But getting back to your threatened lawsuit. Having no insurance against malpractice suits, I advise you to get out as cheaply as you can—either by fighting the case or settling before a suit is started. If you can settle, you had better pay a lawyer to draw up a release, or, if you want it, I can send you a release if you give me the names of the patient and her husband and the particulars as to what is claimed by them."

This Doctor settled the matter for $500, which was much less than he could have fought it for. The claimant's lawyer drew up the release, which was submitted to me, and found adequate and satisfactory.

I take considerable pride in having devised the release form above given, because releases have been a bugbear of the roentgen therapist. In our enthusiasm and anxiety to produce results in some of the apparently incurable conditions, we have most of us used dosage that we knew was excessive, often telling the patients that this was necessary and warning them that there is or will be some risk; but in reality, *we have been the ones who took the risk.* With my release form, I feel that we may rest somewhat easier. I will, at least until it has been decided useless and of no legal force.

HE WANTED TO READ A BOOK WHILE TESTIFYING: WHAT TO DO AND WHY

Recently a friend wrote me: "While on the witness stand yesterday as an expert witness, I wanted and tried to read an extract from Cotton's 'Dislocations and Joint Fractures,' but was stopped by the objections of the plaintiff's attorneys.

"My reason for reading the abstract from the book was merely to verify a statement that I had made during my direct examination, which had been sneered at by the attorney for the other side, during my cross-examination, and in re-direct examination I wanted to prove by this eminent authority that my statement was correct.

"The judge ruled that the objection was 'sustained,' and the attorney for whom I was testifying did not ask that an exception be noted against the judge's decision. I was never so squelched in my life. The attorney for whom I was testifying is an up-and-doing fellow and I had a pretty high opinion of his ability as a trial lawyer until this incident. I was indeed very much surprised. What should I have done? You have had a lot of experience and may have come upon this same thing in your time. Let me hear when you can."

My reply was: "You need not have been at all surprised at the conduct of your legal friend, in not asking for an exception to be noted, *re* the reading of your book. I would say, '*currente calamo*' that he knew the objecting lawyer was right and the point in the objection was so well backed up by precedent and by authorities so numerous, that an exception was a worthless effort, and would merely clutter the record of the case with useless words.

"As regards your objection to being 'sneered at' by the attorney on the other side during cross-examination, permit me to say that *there should be no other side to you as a witness*—though I will admit that there really is to all of us—and that you will have to get used to that sort of treatment if you expect to appear as an expert witness. You will have to develop a hide as thick as that of a rhinoceros and to learn to grin and bear abuse much of the time, on cross-examination.

"However, if and when such abuse becomes so severe as to be unbearable, and the attorneys on the side of the case for which you are appearing do not make an effort to protect you, you may call upon the court for protection. But you should realize that as a rule that is a very unwise procedure, because it places you in the position of being 'unable to take it,' in that the offending attorney has penetrated your reserve and is liable to encourage him to a further like attack upon you, rather than to discourage or reduce the severity of his attack. Personally, I have found when such a procedure is started against me, an amused smile and slow thoughtful answers, carefully worded, and always delivered as though I was absolutely sure of my ground, goes farther to end such treatment and disarm such irritative conduct quicker, and goes farther with the jury (*and it is the jury that the other fellow is trying to influence*). If now you are not or do not appear to be upset by the innuendoes and sneering, insinuating, slurring, belittling mannerisms, the attorney who is using them on you will be the first to note how they affect you, and will govern himself according to that effect.

"Getting back to the reading from the medical book, it is practically a universally accepted rule, that the 'contents of scientific books cannot be read to a jury for the purpose of establishing facts or the establishing of the deductions stated in them,' according to the New York Appellate Court, in Egan *vs.* Dry Dock & B. R. R. (12 App. Div., 556).

"The reasons for excluding books are 'because of the unsettled condition of the science; because the language employed is technical and, therefore, not within the understanding of men of ordinary experience; because of the difficulty of determining what books are or are not of good authority; because such books are written without the sanction of an oath and *the authors are not liable to cross-examination*, and lastly because *such books are but hear-*

say evidence about which living witnesses could be called to testify,' according to Section 1127 Corpus Juris, 1923.

"As to what you should have done—I would say that you should have done *nothing, and worked as hard as possible at it.* As a witness, your business and duty is to answer questions and that only. Any and all other matters except the answering of questions put to you, should and will be attended to by the attorneys.

"In my paper, 'The Medical Expert Witness' in RADIOLOGY for October, 1931, I said, and I still believe that, 'Expert witnesses should not appear to take sides in the trials in which they testify. Their only duty is and should be to give their opinion when asked for it and to answer the questions which they are asked. Any appearance of advocacy or tendency to champion the cause of either side or to become controversial will lead any open-minded and fair jury to immediately conclude that the witness is taking sides, and his testimony will at once be discounted, and the credence originally given it be markedly lowered or even rendered worthless. We have seen witnesses so anxiously trying to create favorable sympathy for the side for which they were appearing that they were almost as bad as the 'Alibi Ike' who was ready to swear that he was at a lodge meeting when he was playing poker.'

"Trusting that I have answered your questions, so as to clear up the points in doubt," etc.

(*To be continued*)

THE ROENTGEN DIAGNOSIS OF OSTEOPOROSIS AND ITS LIMITATIONS[1]

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THE importance of an early x-ray examination of the skeleton has been strongly suggested by recent studies on the influence of endocrine disorders on the metabolism of bone. The biochemist with his laboratory methods including all available chemical and metabolic tests, the clinician with a careful study of the case history and clinical methods, the radiologist with a thorough examination of the skeleton (in addition to the local region in question) must work together to arrive at a diagnosis as early as possible. The time may not be far distant when an x-ray examination of the skeleton will be as much a matter of routine in all affections of the endocrine system as the determination of the basal metabolic rate. This will apply to the adult and the growing organism. For the latter, the study of the appearance of the epiphysial centers and of their fusion with the diaphysis is, already at the present time, an important point of diagnosis. If we recognize the fact that bone is not an inert mass but takes part in all vital processes of the body, we must consider the skeleton as an organ which is responsive to physiological and pathological changes. Seen in this new light, x-ray examination of the skeleton gains new significance. If we see in the skeleton the calcium storehouse of the body, we can easily understand that it may be attacked in all endocrine and metabolic disorders in which we have a disturbance of Ca metabolism.

The close connection between the parathyroids and calcium and phosphorus metabolism has been supported by the clinical finding of parathyroid tumors in cases of osteitis fibrosa cystica, by experimental production of similar bone changes by injection of parathyroid hormone, and by correction of the skeletal symptoms after removal of the parathyroids (Ballin). But the endocrinologist and the radiologist should never forget that in addition to the outstanding local skeletal changes in the form of cysts, fractures, and reactive deformities we nearly always have a general osteoporosis as an expression of the systemic affection. Sometimes, as Dresser and Ballin have shown, general decalcification is the only symptom of bony involvement in cases of parathyroid tumors.

However, it is not as well known that in other endocrine and metabolic disorders we have a general osteoporosis as one of the most important clinical and diagnostic signs of the disease. A great percentage of cases of basophile adenoma of the pituitary gland show general decalcification of the skeleton (Cushing, Rutishauser, Ballin). Askanazy (quoted from Rutishauser) gives the disease the name "osteoporotic adiposity."

A number of observers have reported a pronounced generalized and homogeneous decalcification of the skeleton in hyperthyroidism (Kummer, Golden and Abbott). Dunlap and Moore state that it affects all bones, but, when of moderate or slight degree, it is most readily discerned in the spongy bones and those with superficial coverings, especially skull and ribs, the latter sometimes showing multiple fractures. According to these authors, the degree of decalcification is in direct ratio to severity and duration of the hyperthyroidism.

The relations of the suprarenal glands and the pancreas to Ca metabolism are not clear. The literature shows much discrepancy. Wilder reports cases with pathology of the suprarenals or pancreas which showed general osteoporosis. Golden and Abbott came to the conclusion that al-

[1] Aided by a grant from the Research Appropriation of the University of Oklahoma Medical School.

though adrenal secretion either directly or indirectly influences Ca metabolism, and although the adrenals may be indirectly involved in a pluriglandular imbalance in certain cases of osteomalacia, the evidence does not seem to justify the assumption that decalcification of the bones results directly from adrenal disease or dysfunction. In regard to the pancreas in cases of diabetes with osteoporosis, Golden and Abbott raise the question as to how much of the decalcification may be of endocrine and how much of nutritional origin. According to these authors, evidence is lacking that skeletal decalcification in diabetic adults can be attributed directly to the disease. Ballin finds a connection between early surgical menopause and general osteoporosis.

Another group of diseases associated with general and pronounced demineralization of the skeleton comprises affections due to faulty or insufficient nutrition. To this group belong the hunger-osteopathies, affections produced by a diet deficient in calcium, phosphorus, or vitamin C or D (Beck), such as scurvy, rickets, and osteomalacia, cases with fistulæ of the biliary tract or the pancreas (W. Müller). Also severe dyspepsias in children, as celiac disease and idiopathic steatorrhea (Camp), may be listed. The marked decalcification of the skeleton in renal rickets is probably produced by an imbalance of calcium and phosphorus in the blood (Vogt).

Difficult to classify is senile atrophy. It can be regarded as a physiological process perhaps related to changes in the endocrine system (Cohnheim, quoted from Beck) or as a nutritional disturbance (von Recklinghausen, quoted from Beck).

Finally we may mention general osteoporosis of the skeleton due to congenital hypoplasia of the mesenchyme, often hereditary—a disease called osteopsathyrosis or fragilitas ossium.

From this list of affections associated with general osteoporosis we may omit all those diseases in which decalcification is brought about by replacement of bone structure by pathologic tissue, as in bony metastasis and myeloma or in certain diseases of the reticulo-endothelial system, as Schüller-Christian's syndrome or morbus Gaucher.

Discussing the causes of *local* atrophy we may restrict ourselves to those osteoporotic processes which we find at a distance from the local focus, separated from it by a joint or joints (Friedl and Schinz).

Here we may mention primarily all types of infections of bones, joints, and soft parts, especially tuberculosis, gonorrheal and septic arthritis, rheumatic polyarthritis, and deep-seated affections of the soft parts, then osteoporosis following combustions and congelations (Hitschmann and Wachtel), acute traumatic bone atrophy (Sudeck's atrophy), decalcification in neuroparalytic and neurotrophic disturbances as in Charcot joints, atrophy due to disuse (inactivity), finally atrophy due to pressure as in erosion of bone by aneurysm or in hydrocephalus.

In giving these causes we must keep in mind that we deal only with clinical pictures, not with sharply defined etiologic or pathologic types. It must be well understood that the causes of atrophy, for instance, after a fracture, are very complex. The osteoporosis may be due to neurotrophic and circulatory disturbances or inactivity. There is a voluminous literature dealing with the primary cause of osteoporosis. But from the x-ray point of view this question is irrelevant and will not be discussed in this paper.

Far more important for the radiologist is the pathologic picture. If we keep in mind that in normal bone *in vivo*, an equilibrium exists between appositional and resorptive processes we can easily understand that there are different processes leading to reduction of the bony substances: (1) decreased apposition; (2) increased resorption; (3) a combination of the two. All three processes may occur in different cases. Senile osteoporosis may be named as an example of No. 1, acute (Sudeck's) atrophy as an example of Nos. 2 or 3.

But while we know that in normal bone the formation and resorption of osseous

substance is produced by activity of cells, osteoblasts, and osteoclasts, the mechanism of decalcification in pathologic osteoporosis is still a disputed question. Quite a number of authors believe that there is a real halisteresis, that is, a process in which the lime salts are dissolved, while the matrix is left intact; as though "one treats a piece of bone with hydrochloric acid so that the organic matrix of the bone remains as a flexible, fibrous mass" (Beck). Such experienced observers as Leriche and Policard believe (quoted from Key) that this is the usual mechanism by which bone is resorbed. The difficulty is that it is not possible with present morphologic methods to differentiate between bony matrix which has not been calcified and bone which has been secondarily decalcified. What one author calls undecalcified newly formed osteoid tissue (Pommer), the other calls substance which is deprived of its calcium (halisteretic malacia).

The greater number of observers to-day believe that resorption of bone in pathological decalcification is brought about by *cellular* resorption through osteoclasts. On the external surface of the bone, as well as on the trabeculæ, within the bone, there appear microscopic depressions, the so-called Howship's lacunæ, formed by the activity of osteoclasts. The progressive resorption gradually thins the trabeculæ of the spongious bone and destroys many of them; the cortex also becomes thinned and spongious-like. The marrow spaces become dilated. According to some authors, bone resorption may also be carried out by means of perforating (Volkmann's) canals containing vessels and boring their way through the bony substance.

When the resorption takes place from the external subperiosteal surface of the bone and the diameter of the bone is decreased we call it *concentric atrophy*. It occurs mostly in flat bones (skull, scapula, pelvis). If the bone resorption proceeds from the medullary cavity, the medullary canal enlarges gradually by destruction of the spongious part and thinning of the cortex, but the external shape of the bone may not change greatly. This *eccentric* atrophy occurs mostly in long bones. Both forms may be combined.

On direct examination we find that atrophic bone is light in weight. It is more fragile and can be cut easily. The cortex is porous. The trabeculæ are thinner and less numerous than normal (Maliva).[2]

A histologic diagnosis, *intra vitam*, by biopsy is not possible, therefore, the x-ray method is the only means of diagnosing osteoporosis in the patient. If one sees the long list of diseases wh ch are associated with local or general decalcification, one may question the practical importance of the radiologic diagnosis. Clinical experience has established its significance in a great number of cases. Parathyroidism is often brought to the knowledge of the physician through roentgenograms of the thorax which have been taken for other reasons. We can say that radiography is the most important method in the diagnosis of parathyroidism. The differential diagnosis between dystrophia adiposogenitalis (Froelich's synd ome) and basophile hyperpituitarism (Cushing) is often based on roentgenograms, general osteoporosis occurring only in the latter disease (Rutishauser). Pronounced local atrophy, often after a more or less trivial injury, explains the symptoms of the patient which otherwise would be unexplainable. The prognosis and the success of therapy in rickets, scurvy, and osteomalacia are judged largely from roentgenograms. These examples which every radiologist could supplement with many from his own experience may illustrate the importance of the method.

What are the x-ray findings in osteoporosis? They can be derived from the gross and micropathologic picture only under certain restrictions which are based on the physical and optical qualities of the roentgen rays.

Bone, chemically speaking, is a substance which is composed of water, organic material, and mineral salts, the latter mostly

[2] This rather extensive discussion of the pathology of osteoporosis seemed necessary for the understanding and justification of our experiments.

calcium phosphates, less calcium carbonate, and small amounts of magnesium phosphates and others. According to Schinz, the absorption of the x-rays by a tissue, in other words, the shadow which a tissue casts on the film, is dependent upon:

(1) The quality of the x-ray beam;
(2) The character of the atoms which compose the tissue. (The absorption rises with the fourth power of the atomic number, thus an atom of calcium absorbs forty times as much as an atom of oxygen. In bone the relatively high atomic numbers of phosphorus and magnesium also play a rôle);
(3) The specific weight or physical density of the tissue. (If we assume the specific weight of soft parts to be that of water, the specific weight of bone is nine times that of its surroundings.)
(4) On the thickness (diameter) of the tissue.

From the facts presented we see one limitation in our method: we will be unable to help in deciding whether bone atrophy is brought about by halisteresis or by lacunar and vascular resorption.

The analysis of a roentgenogram would be much easier if bone structure were not so complex. On a cross-section of a long bone we see that it is composed of parts of different thickness and physical density, compact and spongious bone, the latter arranged in trabeculæ which lie at all possible angles to the x-ray beam. From this we may assume that the parts of bones which produce the pattern of the roentgenogram are different in different bones. We know from experience that structural pictures of the skull (in lateral view) are not at all alike. We have seen films in which the diploic (spongious) middle layer was very well defined and others in which this layer was very indistinct. That can easily be explained by the relative thickness of the different layers. Until now the rôle played by the two component structures in the formation of the pattern on the x-ray film has not been determined in the various bones or in different parts of the same bone. In observing the spongious structure of the head of the femur we have to keep in mind that we do not see individual trabeculæ, although they seem so sharply defined in the x-ray film, but that we deal with a superimposed picture which is composed of all the trabeculæ which lie in the plane of the x-ray beam. We do not know the rôle played by lamellæ which lie parallel or nearly parallel to the film. They may take part in bringing about the general opacity of the picture of the bone which is produced to a great extent by the two layers of bone cortex.

Supplied with this knowledge, we may come to a better understanding of the value and limitations of the x-ray diagnosis of osteoporosis. We can easily comprehend that the first stages of decalcification cannot be diagnosed. Our experiments show this quite definitely. As long as bony resorption is within microscopic dimensions it will escape our roentgen eyes. A considerable number of trabeculæ must be destroyed before it is observed in the summation picture. How far decalcification must have progressed to come within the limits of our diagnostic perceptibility, will be shown later.

The first x-ray sign, in the acute stage, is a general increased translucence of the bone. The structural appearance is hazy and blurred. Within the spongious part we see irregular areas of reduced density. The trabeculæ are no longer sharply defined as in the normal, but fade into one another (Kienböck, Sudeck). Later as decalcification progresses, or in primary chronic cases, blurring disappears, the bony texture is sharp, the trabeculæ well defined, but their meshwork is much wider than normal and the individual lamellæ thinner. At the same time the cortex becomes thinner and lamellar. In extreme cases the cortex may become very narrow and appear as though drawn with a fine pencil; the trabecular structure may be almost invisible. The bone takes on a glass-like appearance.

We may find transitions between the first and second stage and mixed pictures. The appearance of some hypertrophic thickened

lamellæ on places where they have important static functions, may serve as a further sign of a chronic case.

ture. Our own experiments refute this, since we obtained the same hazy picture by decalcification of macerated bones without

Fig. 1-*A* (*upper*). Roentgenogram of an osteomalacic rib. (Taken from "Handbuch der speziellen pathologischen Anatomie und Histologie," Berlin, 1929 **11,** 1, p. 120, Fig. 25.)
Fig. 1-*B* (*lower*). Artificially decalcified rib; amount of calcium removed: 54.7 per cent.

The pathology, which was discussed above, furnishes the basis for understanding the x-ray findings, but some of the radiologic signs require special discussion. How can the blurred and spotted picture of the first stage in contradistinction to the clear-cut appearance of the chronic phase be explained? Kienböck thought that the transient impregnation of marrow spaces with dissolved lime salts prevented the normal contrast within the trabecular meshwork and that local accumulation of these lime salts led to the spotted appearance. Friedl and Schinz disproved this theory by showing that the concentration of the dissolved lime salts is not high enough to produce the described effect. According to these authors the normal trabecular structure of bone acts as a Bucky grid in preventing to a great extent the deteriorating effect of secondary rays coming from soft parts outside the bone. With a great part of these lamellæ destroyed, as in acute osteoporosis, scattered rays from soft parts are able to bring about blurring of the picany soft parts. The explanation of the described phenomenon seems to us much simpler if we keep in mind that the x-ray appearance of spongious bone is a product of superimposed structures, not a picture of single layers of bony trabeculæ. In these single layers of lamellæ we find, side by side, all degrees of decalcification, up to complete disappearance. Thus in the roentgenogram which gives us a summation effect, we cannot expect a clear-cut structure as in the normal. The latest histologic examination of very acute stages of bony atrophy by Rieder also confirms the appearance of the affection under the microscope. The destructive processes are more pronounced in some places than in others.

In chronic cases we do not have partial and irregular decalcification of the trabeculæ—they have either disappeared or retain their normal calcium content; some are even hypertrophied. This seems to be sufficient explanation for the well-defined structural picture in this stage.

With the increasing importance of the x-ray method for diagnostic and scientific problems we have to apply the same rules to it as to other scientific procedures. We have to know the limitations and accuracy of our method. One of us (E. L.) has discussed the general underlying principles in a previous paper (25). Applied to our special problem, osteoporosis, we have to ask ourselves:

(1) Is every osteoporosis visible in the film?

Fig. 2-*A* (*upper*). Normal skull cap. Axial and lateral view.
Fig. 2-*B* (*lower*). Same skull cap as shown in Figure 2-*A*. Partly decalcified; amount of Ca removed: 22.5 per cent.

(2) What degree of decalcification must be present before we can diagnose it?

(3) Is the amount of decalcification necessary for diagnosis the same in all bones?

(4) Is it the same in all parts of a given bone?
(5) How delicate is our method, that is: between what degrees of decalcification can we differentiate on the film?
(6) Are there other processes which lead to the same or similar pictures as osteoporosis?

Fig. 2-*C*. Same skull cap as shown in Figure 2-*A*. Further decalcified; amount of Ca removed: 45 per cent.

The clinical and scientific importance of these questions is self-evident. If we know that certain stages of osteoporosis cannot be diagnosed by the roentgenologist, we will not be able to exclude the disease in question by negative findings. Likewise our method would not be suitable for solving the question as to when the first changes in the bones occur—in experiments or after injury? (This problem is of great interest in experiments regarding the cause of osteoporosis.) If the amount of decalcification which is necessary to make it visible differs in different bones, we cannot decide from the roentgenograms where an osteoporotic disease starts. Hence, such statements as that a disease begins in such and such a bone or is localized in certain bones only, when based on the x-ray findings, are on weak foundation; for instance, the statement of Sudeck and others that in most cases acute atrophy occurs only in the hands and feet. If the amount of decalcification which is necessary for the first demonstration in the x-ray film is different in different parts of the same bone, we cannot state that decalcification starts or is localized only in the epiphysial ends, while the diaphysis remains free. Recently the question of the site of bone lesions in experimental hyperparathyroidism has aroused great interest. We must ask ourselves if it is permissible to base the conclusion on x-ray findings alone, or if these must not be supported by physico-chemical and histologic examinations. At present the x-ray method is used to test quantitatively the vitamin D effects on rats (Bourdillon and Bruce). Again the question arises: Is our method reliable enough for quantitative determinations? Finally, Point 6 contains the problem of differential diagnosis. This will be

discussed from the viewpoint of general clinical and radiological experience.

In order to approach the other problems just mentioned we have to make use of experiments which simulate natural conditions as closely as possible. Since the physical factors of density and thickness, as discussed above, play such an important rôle for visibility of bone affections, we have to exclude experiments on animals (especially on small animals) in which we find conditions absolutely different from those in man in regard to the structure and diameter of the bone. The only figure as to the degree of decalcification necessary for visibility in the roentgenogram available in the literature, is to be found in Baastrup's paper and is based on experiments on the calcaneus of rabbits. Unfortunately the dimensions of our patients' bones are not at all like those in a rabbit's foot. If we, therefore, work on human macerated bones, we have to take into account one disadvantage, namely, that of bringing about the decalcification not in a biologic way, but by use of acids. We think we are justified in so doing since x-rays deal in any case only with mineral matter and, as discussed above, the finer biologic process of osteoporosis is beyond the range of our method. The fact that quite a number of experienced observers still believe in simple halisteresis may further justify our experiments. Figure 1 shows the comparison between an osteoporotic bone in osteomalacia and a rib which we have decalcified with acid. We see the great similarity in the x-ray findings. It is evident that with our experiments we can imitate only the more acute stages of bone atrophy, while the chronic type of osteoporosis with its additional reparative processes is not accessible to our type of experiments.

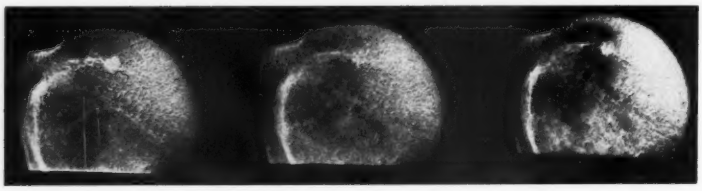

Fig. 3-*A*. Head of humerus, split and paraffined on the outside, otherwise untreated.

Fig. 3-*B*. Head of humerus from the opposite side of the same cadaver. Split and paraffined on the outside and partly decalcified from the inside. Amount of Ca removed: 15.9 per cent.

Fig. 3-*C*. Same bone and treatment as in Figure 3-*B*. Amount of Ca removed: 39.2 per cent.

EXPERIMENTAL

The weight records and roentgenograms of two macerated identical bones, belonging to the same human cadaver, were taken. One of the two bones was then placed into 10 per cent nitric acid, the other used as a control. After a certain time, varied according to the bone treated, it was removed from the acid, a sample of the fluid for determination of the calcium content was taken, and the bones were roentgenographed. It was then replaced in the acid. This procedure we repeated until we secured pronounced results on the film, the acid being renewed as often as necessary. After completion of the experiments we ashed the bone and determined the calcium content of the residue.

Calcium determinations were made in all cases on the samples taken at intervals while the bone was being treated with acid, and on the extract made from the ash of the remainder of the bone. After demineralization had been carried as far as desired by direct treatment with acid, the bone was ashed in a muffle furnace at a temperature not above 500° C., after which the ash was dissolved in hydrochloric acid. An aliquot was used for calcium determinations. In each case the *p*H of the samples was carefully adjusted and the calcium determined, according to the

method of Clark and Collip. The Fiske and Subbarow method was used for phosphorus determinations.

gard to the visibility of decalcification, we separated the epiphyses from the diaphysis, treating them in different containers,

Fig. 4-*A*. Fig. 4-*B*.

Fig. 4-*A*. Distal end of humerus, split and paraffined on the outside, otherwise untreated.

Fig. 4-*B*. Distal end of humerus, from the opposite side of the same cadaver. Split and paraffined on the outside and partly decalcified on the inside. Amount of Ca removed: 25.2 per cent. Picture shows only slight blurring of the bone structure.

In a series of experiments the phosphorus which had been dissolved from the bones was determined. Later this was discontinued, since we found a fixed relation between the calcium and phosphorus content. We soon changed our arrangement for the long bones since we saw that the result was a decalcification of the cortex only and the roentgenograms were not like those we find in osteoporosis. We split our long bones lengthwise, vertical to the direction of our x-ray beam. In order to protect the outer surface of the bones from being attacked by the acid, the bones were paraffined so that the acid acted on the cut surface only. Thus we tried to imitate the eccentric type of atrophy. In flat bones like scapula, skull, and ribs, where, in the living, we have a concentric atrophy also, we continued the procedure as first described. In this manner we treated different types of bones, as can be seen from the tables. In order to determine whether or not the different portions of the same bone behave alike in re-

the single parts always split and paraffined on the outside. The corresponding control bone was likewise split and paraffined.

The results of our experiments can be seen from Tables A and B. They are given in the percentage of calcium which is taken out of the bone. The column "first (faint) appearance" states the first signs of decalcification which often could be discovered only with the hand lens and only by careful comparison with the control. In giving figures for the *distinct* appearance of osteoporosis we desired to state the approximate grade of decalcification which we would expect to be visible in the living. In order to find out the deteriorating effect of soft parts we built a paraffin phantom around the head of the humerus of the same thickness and approximately the same absorption for x-rays as the soft parts in the living. It increased the values about 5 to 10 per cent. But there are still other reasons for making the results in patients more unfavorable than in our experiments. In general osteoporosis an exact comparison with a control is not available. Compari-

TABLE A.—EXPERIMENTS IMITATING CONCENTRIC ATROPHY

Name of Bone or Part of Bone	First (Faint) Appearance of Decalcification in Percentage of Calcium Removed	Distinct Appearance of Decalcification in Percentage of Calcium Removed
Rib	25.8	33.8
Skull	22.5	45.0
Scapula	19.25	29.95

TABLE B.—EXPERIMENTS IMITATING ECCENTRIC ATROPHY

Head of humerus	7.25	15.90
Diaphysis of humerus	11.55	18.00
Distal end of humerus	21.4	41.3
Calcaneus	7.6	14.2
Metacarpal	12.15	Between 19.35 and 33.34
Navicular	15.10	Between 25.60 and 39.30
Vertebra	8.40	14.21

sons with roentgenograms of another patient of the same age, weight, and physical activity (Dunlap and Moore) are of limited value because of the normal variations even if the named factors are the same. The technical conditions under which the roentgenogram is taken are also of great importance. We worked, of course, under optimal conditions: this is not always possible in the patient. We can produce the impression of atrophy in normal bone with too penetrating rays. Likewise we can conceal decalcification by working with too low voltage. In case of atrophy or swelling of the soft parts an exact comparison with the normal side would be impossible. In bones with parts of different thickness, as in the scapula or vertebra, it will not be possible to get the optimal penetration for all parts on the same picture. Thus we can say that, on the average, the figure for the lowest visible decalcification is much higher than that given in the literature, which is 10 to 15 per cent (Baastrup, Brandes, Grashey). The diameter of the bone seems to be of less importance for the visibility of early changes, as shown by the high figures for rib, the navicular, and the metacarpal bone, than structural composition; that is, the relative amount of compact and spongious bone.[3] Bones with a great amount of spongious texture and relatively thin cortex give the most favorable results. In this re-

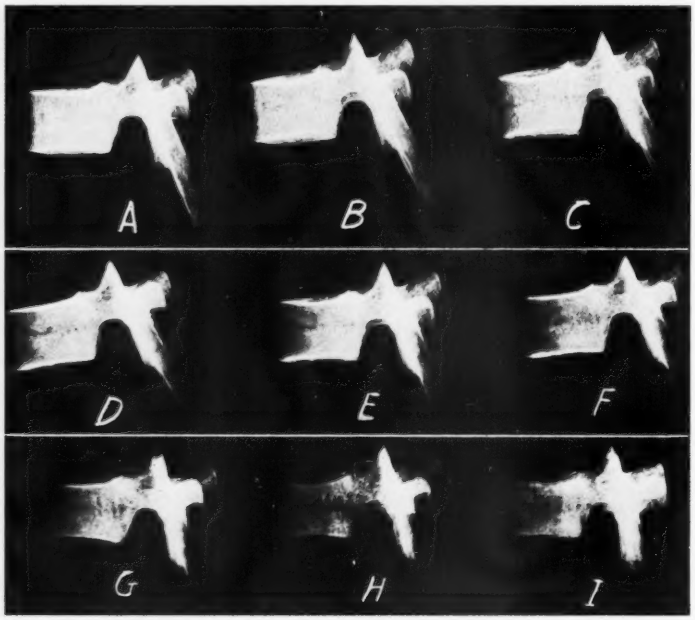

Fig. 5. Dorsal vertebra. Split and paraffined on the outside, decalcified from the inside. All illustrations are made from the same bone with gradually increasing decalcification. *A*, control; *B*, Ca loss 4.85 per cent. No change in the x-ray appearance in comparison with the control: *C*, Ca loss 8.4 per cent. Slight decalcification especially in spinous process: *D*, Ca loss 14.21 per cent. Blurring of the spongious structure all over the bone: *E*, Ca loss 20.4 per cent. No change in comparison with *D*. *F*, Ca loss 23.5 per cent. Increased translucency in the anterior part of the bone: *G*, Ca loss 35.4 per cent. Further decalcification: *H*, Ca loss 39.4 per cent. Marked deepening of the groove of the central vein: *I*, Ca loss 44.6 per cent. Spongious structure gradually disappearing. First faint appearance of decalcification after Ca loss of 8.4 per cent. Distinct signs of decalcification after Ca loss of 14.21 per cent.

[3] The method of our experiments is not the cause of the high figure obtained in the small bones listed. In a group of experiments we decalcified two bones of the same type, one from the outside, the other from the inside. The figures for the navicular are in both cases high—around 30 per cent.

spect also the behavior of different parts of the same bone is very interesting. While the head of the humerus permits us to recognize very early changes, the distal end shows up only high grades of decalcification and then not very distinctly. The resistance of the skull picture to an early diagnosis of osteoporosis is also remarkable. The illustration and tables may illustrate the facts mentioned. We rarely have asked ourselves, in a given case of pronounced osteoporosis, how much calcium has been taken out or what degree of decalcification is necessary to produce such a picture. In answering this question our estimation would probably have been much too low. A decalcification, as we see it in the case of the osteomalacic rib (Fig. 1-*A*), probably corresponds to a loss of calcium of about 60 to 70 per cent. The amount of calcium we have taken out in Figure 1-*B* is 54.7 per cent.

Summarizing our results we may say:

1. Only under the most favorable circumstances can decalcification less than 20 per cent be diagnosed.

2. The percentage of calcium loss in most bones must be higher in order to be visible.

3. The amount of decalcification necessary for diagnosis varies considerably in different bones and in different parts of the same bone.

4. The structural composition of bone rather than the diameter seems to be the deciding factor.

We understand now why authors who have determined the site of early experimental osteoporotic lesions have found that trabecular structures are the first to be involved (Bauer, Aub, Albright). These results may be correct, but, as we have said, they have to be supported by chemical and histologic examinations.

The question of the latent stage of osteoporosis which has interested so many authors (Grey, Carr, and Brandes; for literature, see Friedl and Schinz) and which is answered so differently appears now in a new light. Since the x-ray method is the only one available for this problem, we have to speak of this stage as latent only from the x-ray point of view and not to mistake it for a definite clinical period.

In determining the exactness of our method in osteoporosis we paid special attention to the question: Between what degrees of decalcification can we differentiate? For the head of the humerus the answer is, that differences around 7 per cent seem to be recognized. In the calcaneus even smaller differences were recognizable in the lower stages of decalcification: in the skull the exactness was much less. From this we draw the conclusion that we have to be very cautious if we want to use x-rays for quantitative examinations.

In a last group of experiments we tried to determine the relative part played by the two bony structures—the cortex and the spongious layer—in forming the roentgenogram. Our starting point was the consideration: If we decalcify two bones of the *same* type, one from the outside, the other from the inside, the result would show up the relative significance of each part. In the event that we obtain positive results by destruction of the spongious part with less decalcification than by dissolving the cortex, we can say that the spongious layer is more important for the picture than the cortex, or *vice versa*. While our series is not large enough to allow us to come to final conclusions, we may say that in bones with a large spongious portion, as in the calcaneus or vertebra, the result was distinctly in favor of the spongious portion. In other types, for instance, the navicular, the shares of the cortex and spongious bone in forming the picture seem to be equal.

In discussing the difficulties of diagnosis from the viewpoint of practical experience we may direct our attention to those parts of bones which are normally more translucent than other portions of the same bone and which, on the x-ray film, are usually over-exposed: The greater tubercle of the humerus, the greater trochanter of the femur, the body of the calcaneus, the acromion, the fossa supra- and infraspinata of the scapula, Ludloff's spot in the distal end of the femur, the spinous process

of the vertebra, the styloid process of the radius and others. The difficulty is increased since these parts often exhibit atrophy earlier than other parts (from reasons discussed above).

Rarely will the roentgenogram reveal the *cause* of atrophy from the character and localization of the affection. Camp mentions the miliary granular type of osteoporosis in hyperparathyroidism as distinct from the ordinary type of decalcification seen in other diseases. The special localization of bony atrophy in the pelvis and spinal column in osteomalacia is known. What may appear as localized decalcification in a single film may be part of a generalized demineralization. The peculiar subperiosteal lamellation of the cortex in special types of atrophy may imitate a periosteal apposition.

Probably the greatest difficulty in the differential diagnosis is to distinguish osteoporosis from actual destructive processes, especially at the onset of the affection. Tuberculosis and tumor in particular have to be excluded. In cases of tumor or tuberculosis the focus is often thought to be larger because of the accompanying demineralization. "Decalcified bone adjacent to an infective focus may appear to be destroyed. In tuberculous disease the area of destruction is much less than the area of decalcification. In osteolytic sarcoma the tumor is less extensive than the x-ray suggests" (Watson-Jones and Roberts). Special types of diffuse miliary metastatic carcinosis or myelomatosis may imitate very closely diffuse osteoporosis (Dunlap and Moore, and Hanhart). Studies of the whole skeleton and further roentgenologic examinations at definite time intervals will give better information.

In most cases in which the radiologist, after considering the differential diagnostic points in question, comes to the diagnosis "bone atrophy," either generalized or local, he should be satisfied, bearing in mind that he has furnished a most important help for the final diagnosis which usually can be reached only in co-operation with the clinician.

SUMMARY AND CONCLUSIONS

A thorough understanding of the x-ray signs of osteoporosis requires a knowledge of its gross and micropathologic picture as well as of the physical and optical qualities of the x-rays.

A discussion of these factors and of the differential diagnosis of osteoporosis leads us also to the recognition of the limitations of the roentgen method. Further limitations are pointed out by decalcification experiments on macerated human bones. Our experiments attempt to imitate concentric and eccentric atrophy as we find it in the living. Thus we come to the following conclusions:

1. The x-ray method is unable to help in deciding whether bone atrophy is produced by halisteresis or by cellular resorption.

2. The figures given in the literature for the least visible decalcification (10–15 per cent) are based on animal experiments and are too low. Only under very favorable circumstances can decalcification under 20 per cent be diagnosed. In most bones the calcium loss, in order to be visible, must be in the vicinity of from 20 to 40 per cent.

3. The amount of decalcification necessary for diagnosis varies considerably in different bones and in different parts of the same bone as shown by our experiments. The structural composition of the bone rather than the diameter seems to be the deciding factor.

4. Under favorable circumstances the x-ray method detects 7 per cent differences in the degree of decalcification.

5. Negative x-ray findings do not exclude osteoporosis. The x-ray method is unable to determine the point of origin of osteoporosis.

6. The latent stage of bone atrophy is latent only from the x-ray point of view and is not a definite clinical period.

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UTERINE CORPUS CANCER[1]

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THIS study has been made in an attempt to obtain a clearer conception of the relationship between the clinical-pathologic picture of uterine corpus cancer and the end-results following irradiation alone and irradiation combined with hysterectomy. It represents a review of 197 cases admitted to this Institute up until September, 1933. Only those cases in which microscopic material and complete follow-up records are now available have been selected. Statistics, although they make tiresome reading, are necessary in arriving at comparative conclusions.

No other organ in the body passes through so many gross and histologic changes, or is the subject of quite so many functional, mechanical, or chemical irritations and abuses as the uterus. It is clear, therefore, that any degree of metabolic change bears some relation to subsequent pathologic findings.

With the knowledge that malignant neoplasms often vary in their response to irradiation in proportion to a degree of histologic differentiation, and, enlightened by the reports of Healy and Cutler (1), Mahle (2), Lindsay (3), Norris and Vogt (4), pertaining to the end-results of irradiation, surgery, or both in these same types of neoplasms, a division of all cases into six pathologic types has been made. It may be argued that too much distinction is favored in making such a classification, but this microscopic analysis is carried out mainly from a diagnostic viewpoint. The greatest part of our material is from curettage, and the main emphasis is placed on an attempt to arrive at our conclusion from such tissue analysis. We have the following types with a description of each.

(1) *Adenomalignum* I. — A papillary growth, showing no invasive characteristics, projects into the uterine cavity. The papillæ are small, quite regular, and uniform. The cells lining the alveolar arrangements show mild degrees of hyperchroma-

Fig. 1.

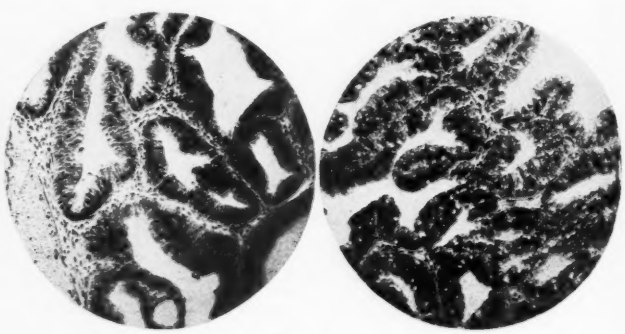

Fig. 2.

Fig. 1. Adenomalignum I. Case No. 1,012, admitted June 26, 1925, 61 years of age. Single; menopause at 53; hemorrhage for one year; discharge for nine months; no operation; uterus enlarged and nodular. Treatment: high voltage x-ray and radium tubes, two courses. The patient is alive and well.

Fig. 2. Adenomalignum II. Case No. 8,833, admitted Dec. 12, 1924, 64 years of age. Married; three normal pregnancies; menopause at 55; bleeding and discharge for past three years; uterus enlarged. Treatment: high voltage x-ray and radium tubes, two courses. The patient died on July 27, 1934. Metastasis to inguinal nodes was found.

[1] Presented before the Radiological Society of North America, at the Twenty-first Annual Meeting, in Detroit, Dec. 2-6, 1935.

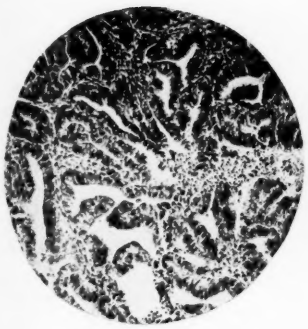

Fig. 3.

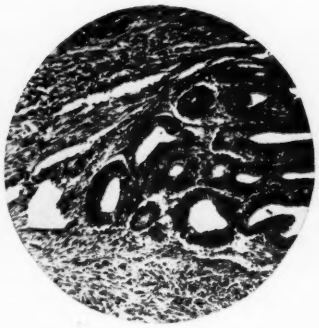

Fig. 4.

Fig. 5.

Fig. 3. Adenomalignum II. Case No. 8,118, admitted Aug. 13, 1923, 50 years of age. Married; no pregnancies; menopause at 45. Five years ago the patient had one hemorrhage, and has flowed almost constantly since. Some low abdominal pain. A supravaginal hysterectomy was done in May, 1923. On admission, the cervix was present and bled easily. Treatment: high voltage x-ray and radon tubes. The patient is alive and well.

Fig. 4. Adenomalignum II. Case No. 16,999, admitted Nov. 14, 1932, 50 years of age. Married; showing deepest glands of a very fungating tumor mass; seven normal pregnancies; menopause 50 years (operation). A supravaginal hysterectomy was done on Oct. 8, 1932. Seven years previously, she began to hemorrhage at frequent intervals, sometimes profusely; there was also a discharge. Treatment: high voltage x-ray, one course. Patient is alive with no recurrence.

Fig. 5. Adenocarcinoma *A*. Case No. 12,067, admitted July 17, 1929, 50 years of age. Married; two normal pregnancies; menopause at 49; hemorrhage, backache, and pains in lower lateral abdomen for four months before supravaginal hysterectomy was done on June 8, 1929. Treatment: high voltage x-ray and radium tubes, two courses. The patient is alive but with a recurrence in the pelvis.

tism and occasional mitosis. They are often in a single layer, although some areas may show "piling up." The stroma is not abundant and consists of spindle-shaped connective tissue cells, blood vessels, and lymphatics. Healy and Cutler (1) say, "Some cases are extremely difficult to distinguish from adenomatoid endometritis." A most careful study of this type satisfied us as to the malignant status. There are nine cases, four having been operated upon.

(2) *Adenomalignum II.*—It is an accentuated degree of adenomalignum I, and quite easily distinguishable by the enlarged glands which form a fungating tumor mass. No invasion of the myometrium is seen, although a diligent search may reveal occasional areas in which glandular elements are surrounded by myometrium; these are not common. The stroma is scant and may in some sections appear almost lacking due to the preponderance of convoluted, papillary, glandular structures, which cells show marked malignant characteristics and reduplication. This results in the picture of several layers of cells encroaching upon the glandular lumen and often occluding it. So may be formed solid masses, especially along the main trunk of the tree-like arrangement. Cullen (5) concludes, "Since the frame work is so scanty, it is only natural that with continued progress of the growth, the older portions should gradually break down."

There were 76 cases in this type, 23 having been operated upon.

(3) *Adenocarcinoma A.*—The adenocarcinomas have been divided into two types, designated *A* and *B*. It is based solely upon the difference in structural differentiation and degree of loss of polarity.

Type *A* shows infiltrating cellular elements, arranged in glandular fashion, with an attempt at reproduction of endometrial glands. The cells are very atypical and characteristically malignant. The majority of glandular structures are lined by one or few layers of cells, but little or no occlusion of lumen is present.

There were 75 cases in this type, 29 having been operated upon.

(4) *Adenocarcinoma B.*—The glandular structure is very scant, the cells forming solid masses and filling up what was in-

Fig. 6.

Fig. 7.

Fig. 6. Adenocarcinoma *A*. Case No. 11,713, admitted March 15, 1929, 39 years of age. Married; seven normal pregnancies; hemorrhage for the past four months; uterus enlarged and fixed; cervix infiltrated and ulcerating. Treatment: high voltage x-ray radium tubes and radon seeds, two courses. The patient died on March 20, 1930. Entire pelvis was infiltrated.

Fig. 7. Adenocarcinoma *A*. Case No. 12,027, admitted July 3, 1929, 41 years of age. Married; showing a few glands filled with malignant cells; one normal pregnancy, two abortions; bleeding steadily for past eight months; some yellowish discharge; uterus enlarged and nodular; cervix lacerated and patulous. Treatment: high voltage x-ray, radium tubes and radon seeds, one course. The patient is alive and well. Uterus is normal in size and the cervix is smooth.

tended to be lumen. Polarity is lost, but throughout one may distinguish an abortive attempt to form glands like those seen in type *A*.

Of course, pictures of both *A* and *B* may be seen in a single case, just as some sections of adenocarcinoma *A* may show areas resembling adenomalignum II. The preponderant and what appears to be the most malignant and less differentiated phase has determined the final classification.

There were 20 cases in this type, three having been operated upon.

(5) *Diffuse Anaplastic Carcinoma.*—In this type no structural differentiation is seen. Masses of atypical, round and polyhedral cells with hyperchromatic and mitotic nuclei are arranged in sheaths or columns infiltrating the myometrium.

There were 15 cases in this type, four having been operated upon.

(6) *Adeno-acanthoma.*—Von Rosthorn (6) and Zeller (7), in 1894, described squamous epithelium found in the body of the uterus. About the same time, Kaufmann (8) reported a tumor of the uterine body in which were present both an adenocarcinoma and a squamous-cell carcinoma. Lahm (9) states that squamous epithelium with distinct keratinization may be found in nearly all adenocarcinomas of the body of the uterus. He regards this keratinization as an attempt at healing. Ewing says, "Squamous cells may form a prominent element in adenocarcinoma of the corpus, and in rare cases they predominate over the glandular structure and produce a true adeno-acanthoma."

Pearl formation and sheaths of flat keratinized malignant cells are associated with adenocarcinomatous structures, which are mingled in some sections and separate in others. We have only two such cases, neither having been operated upon. Nowhere will we discuss them as a separate type due to the small number. They will, however, be found analyzed in the different

charts and included in the summarized statistics.

AGE

On admission, the average age of all the cases in this series is 58.8 years. The individual figure for each pathologic type as recorded in Chart I varies from 56.2 years in the adenocarcinoma *A* type, to 61 years in the adenomalignum II type. Both the youngest and oldest patients were in the adenocarcinoma *A* type, the ages being 35 and 79 years, respectively.

Of the cases operated upon, the average age was 55.5 years, and of those not operated upon, the average age was 60.4 years. The anaplastic carcinoma type was the only type in which this age variance was not so pronounced, a difference of only 1.4 year being present.

MARRIAGE, PREGNANCY, AND MENOPAUSE

It is interesting to observe the functional history of the uterus in various types. An analysis of all cases revealed an average of 87.8 per cent married: none of the unmarried cases gave a history of pregnancy. Of the married group, 24.8 per cent were never pregnant, making the corresponding figure for the entire series 34.5 per cent.

Of the total number married, 31.2 per cent never had a normal confinement. In this respect the diffuse anaplastic carcinoma type leads with a percentage of 41.6. The adenomalignum II type had the lowest figure, 26.1 per cent. The former type also had the highest percentage of cases never pregnant, 46.6 per cent. The total number of normal births average about the same in each type (2.8 to 3.4), with the extremes being one to twelve.

Abortions and miscarriages (apparently not induced) were common in all types, 24.8 per cent. Percentages of incidence vary from 20 in the diffuse anaplastic carcinoma type, to 33.3 in the adenomalignum I type. The greatest average number occurred in the diffuse anaplastic type, one case having had six abortions or miscarriages. In the married cases, abortions or miscarriages occurred in 29 per cent, the greatest incidence being in the adenomalignum I type (37.5 per cent), and the lowest figure being in the adenomalignum II type (24.7 per cent).

Stillbirths occurred in only 4 per cent of all cases. The incidence varied from 2.6 per cent in the adenomalignum II type to 6.6 per cent in the diffuse anaplastic carcinoma type. None occurred in the adenomalignum I type, and no patient had more than one stillbirth. Of the married cases, stillbirths were in only 4.7 per cent, the greatest incidence being in the diffuse anaplastic type (8.4 per cent).

On admission, 74.6 per cent had passed a natural menopause, while 8.1 per cent had had an artificial menopause due to opera-

CHART I.—AGE ON ADMISSION—GROUPS OPERATED AND NOT OPERATED UPON

Type	No. of Cases	Operated on, Not Operated on, and Total	No. of Cases	Average Age on Admission	Oldest	Youngest
Adenomalignum I	9	OP	4	54.5	62	45
		Not OP	5	63.	68	59
		Total	9	59.2	68	45
Adenomalignum II	76	OP	23	57.6	70	37
		Not OP	53	62.5	78	45
		Total	76	61.	78	37
Adenocarcinoma *A*	75	OP	29	54.1	67	35
		Not OP	46	57.6	79	39
		Total	75	56.2	79	35
Adenocarcinoma *B*	20	OP	3	51.3	62	42
		Not OP	17	61.7	76	47
		Total	20	60.1	76	42
Diffuse Anaplastic Carcinoma	15	OP	4	56.2	66	50
		Not OP	11	57.6	71	43
		Total	15	57.2	71	43
Adeno-acanthoma	2	OP	...	....	..	..
		Not OP	2	67.	75	59
		Total	2	67.	75	59
Summary	197	OP	63	55.5	70	35
		Not OP	134	60.4	79	39
		Total	197	58.8	79	35

tion, and in one case due to x-ray. The figures for the separate types as seen in Chart III vary considerably. Natural menopause was most prevalent in the adenomalignum I type, 88.8 per cent, and adenomalignum II type, 86.8 per cent. It was least frequent in the adenocarcinoma *A* type, 61.0 per cent, and diffuse anaplastic type, 66.6 per cent. The average age when natural menopause occurred was 48.5 years, with the extremes being 36 and 57 years. The average age incidence for the separate types varied from 48.2 years to 50.1 years.

SYMPTOMS

Bleeding.—The most constant complaint was bleeding; 94.4 per cent of all our cases had this symptom. It was either a steady "spotting," especially on trauma or defecation, or hemorrhagic. Often both types are present in the same patient. Norris (11) states, "The development of hemorrhage in a patient in whom the menopause has been definitely established, and in whom the ordinary pelvic examination is negative, is more likely to be due to carcinoma of the fundus than to any other cause." Premenopausal bleeding is metorrhagic in character, and progressive in frequency and quantity.

All of the diffuse anaplastic carcinoma cases had this complaint, while the percentages in the other types varied from 88.8 (adenomalignum I type) to 95 per cent (adenocarcinoma *B* type). This is in direct proportion to the increase in microscopic malignant degree.

Discharge.—This is the next most common complaint (42.1 per cent of all cases). If often precedes the onset of bleeding, and at first is clear and serous or sero-purulent in character. Later it becomes brownish and blood tinged. As the disease progresses, tumor necrosis causes malodorous changes. It was most prevalent in the adenomalignum I type (66.6 per cent) and adenocarcinoma *B* type (65.0 per cent), and least frequent in the diffuse anaplastic type (20 per cent), with the adenomalignum II type and the adenocarcinoma *A* type having percentages of incidence of 46 and 34.6 per cent, respectively.

Comparing the incidence in the combined adenomalignum types, adenocarcinoma types, and diffuse anaplastic carcinoma types, the percentages respectively are 48.4, 41, and 20 per cent. Thus, it is

CHART II.—MARRIAGE, PREGNANCY, ABORTION, STILLBIRTH—NUMBER OF CASES AND PERCENTAGE OF INCIDENCE

Type	Total No. in Each Type	No. and Per Cent	Married	Single	One or More Normal Births	Nullipara	Average No. of Births	Greatest No. of Births	Abortion	Average No. of Abortions	Greatest No. of Abortions	Stillbirth	Average No. of Stillbirths	Greatest No. of Stillbirths	Total No. Never Pregnant	Married and Never Pregnant	Married but No Normal Births	Married but No Abortions	Married but No Stillbirths
Adenomalignum I	9	No.	8	1	5	4	3.4	10	3	1.3	2	...	..	..	4	3	3	5	8
		%	88.9	11.1	55.5	44.5	..	..	33.3	..	..	...	..	..	44.5	37.5	37.5	62.5	100.
Adenomalignum II	76	No.	65	11	48	28	3	12	16	1.4	3	2	1	1	23	12	17	49	63
		%	85.5	14.5	63.1	36.9	..	..	21.	..	..	2.6	..	..	30.2	18.4	26.1	75.3	96.9
Adenocarcinoma *A*	75	No.	68	7	45	30	3.1	10	19	1.8	5	4	1	1	28	20	22	48	64
		%	90.6	9.4	60.	40.	..	..	25.3	..	..	5.3	..	..	36.8	29.4	32.3	70.5	94.1
Adenocarcinoma *B*	20	No.	18	2	12	8	2.8	7	7	1.1	2	1	1	1	5	3	6	11	17
		%	90.	10.	60.	42.2	..	..	35.	..	..	5.2	..	..	25.	16.6	33.3	61.1	94.4
Diffuse Anaplastic Carcinoma	15	No.	12	3	7	8	3.3	8	3	2.6	6	1	1	1	7	4	5	9	11
		%	80.	20.	46.6	53.4	..	..	20.	..	..	6.6	..	..	46.6	33.3	41.6	75.	91.6
Adeno-acanthoma	2	No.	2	....	1	1	5	5	1	1	1	...	..	..	1	1	1	1	2
		%	100.	....	50.	50.	..	..	50.	..	..	...	..	..	50.	50.	50.	50.	100.
Summary	197	No.	173	24	118	79	3	12	49	1.6	6	8	1	1	68	43	54	123	165
		%	87.8	12.2	59.8	40.2	..	..	24.8	..	..	4	..	..	34.5	21.8	27.4	62.4	83.2
Total Percentage in Married Cases															39.3	24.8	31.2	71.	95.3

found that the incidence is in proportion to the degree of structural differentiation, with the notable exception of the adenocarcinoma *B* type, wherein 13 out of 20 patients had vaginal discharge.

Complicating conditions such as endocervicitis, senile vaginitis, etc., due to causes other than the corpus cancer, may be factors in detracting from the accuracy of such statistics.

Of the group not operated upon, 47.4 per cent had discharge, as compared to 30.6 per cent of the operated group.

Pain.—This is not an early symptom. It is usually pelvic or low abdominal in location, and of a dull aching character.

Fig. 8.

Fig. 8. Adenocarcinoma *A*. Case No. 12,651, admitted Jan. 22, 1930, 42 years of age. Married; one normal pregnancy, one abortion (induced). A supravaginal hysterectomy was done in December, 1929. One month previous to operation, the patient had some low abdominal pain and bleeding. Treatment: high voltage x-ray, three courses; radon seeds to cervix, one course. The patient died on Oct. 5, 1932. The pelvis was infiltrated.

CHART III.—MENOPAUSE ON ADMISSION—NATURAL AND ARTIFICIAL. PERCENTAGES AND AGES

Type	No. Cases in Each Type	Natural Menopause				Artificial Menopause			
		Percentage	Average Age	Oldest	Youngest	Percentage	Average Age	Oldest	Youngest
Adenomalignum I	9	88.8	48.7	53	43	11.1	54	54	54
Adenomalignum II	76	86.8	48.4	57	36	6.5	47.1	54	37
Adenocarcinoma *A*	75	61.	48.7	56	38	10.6	44.1	61	18
Adenocarcinoma *B*	20	75.	48.2	57	36	5.	50	50	50
Diffuse Anaplastic Carcinoma	15	66.6	50.1	55	45	6.6	29	29	29
Adeno-acanthoma	2	100.	49	50	48	..	..	..	..
Summary	197	74.6	48.5	57	36	8.1	45	61	18

Occasionally it may be quite sharp and colicky. When uterine secretion is dammed back, the patient may complain of an uneasiness in the region of the uterus (Cullen, 5). Extra-uterine extension, pressure on the sacral plexus due to growth and adhesions, are often responsible for pain in the late stages. An analysis of those cases which complained of pain revealed that out of 56 cases only 16 showed evidence of extra-uterine involvement, such as masses in pelvis, induration of vault of vagina, etc. Twenty per cent of the group not operated upon, and 63.6 per cent of the operative group, who had pain, showed these signs. There were, however, 14 cases not operated upon and 29 operative cases which showed extra-uterine involvement, which did not have pain.

In Chart IV, the percentages of incidence are found to be progressively higher, as the increase in histologic malignancy, with the exception of the diffuse anaplastic type in which the corresponding figure is lowest. Altogether, 28.4 per cent of our cases had pain. Comparing the group operated upon with those not operated upon, the percentages are 17.7 and 33.3, respectively. Maybe this is due to a later stage of involvement in this second group. The occurrence of pain did not appear to signify any worse prognosis in the average case,

CHART IV.—SYMPTOMS AND SIGNS—PERCENTAGE OF INCIDENCE

Type	Operated on, Not Operated on	No. Cases in Group	Percentage Uterine Bleeding	Percentage Vaginal Discharge	Percentage Pain in Abdomen	Percentage Low Backache	Percentage Urinary Complaints	Percentage Loss of Weight	Percentage Uterus Enlarged	Percentage Mass in Pelvis	Percentage Vaginal Wall Metastases
Adenomalignum I	OP	4	100.	25.	25	....	....	....	....	50.	....
	Not OP	5	80.	100.	20	20.	....	40.	100.	....	....
	Total	9	88.8	66.6	22.2	11.1	....	22.2	55.5	22.2	....
Adenomalignum II	OP	23	95.	40.9	13.6	4.5	13.6	22.7	....	40.9	27.2
	Not OP	53	92.6	48.1	29.6	18.5	5.5	16.6	74.	9.2	1.8
	Total	76	93.4	46.	25.	14.4	7.8	18.4	52.6	18.4	9 2
Adenocarcinoma *A*	OP	29	89.6	24.1	26.9	13.8	17.2	3.4	....	65.5	17.2
	Not OP	46	97.8	41.3	39.1	15.2	15.2	6.5	89.1	19.5	8.7
	Total	75	94.6	34.6	32.	14.6	16.	5.3	54.6	37.3	12.
Adenocarcinoma *B*	OP	3	66.6	66.6	....	33.3	....	....	....	66.6	....
	Not OP	17	100.	64.7	47.	17.6	29.4	....	94.1	35.3	5.8
	Total	20	95.	65.	60.	20.	25.	....	80.	40.	5.
Diffuse Anaplastic Carcinoma	OP	4	100.	....	25.	....	....	....	....	50.	25.
	Not OP	11	100.	27.2	18.1	18.1	18.1	18.1	81.8	45.4	18.1
	Total	15	100.	20.	20.	13.3	13.3	13.3	60.	46.6	20.
Adeno-acanthoma	OP	...	....	....	....	....	....	....	....	....	....
	Not OP	2	100.	....	....	50.	50.	....	50.	....	....
	Total	2	100.	....	....	50.	50.	....	50.	....	....
Summary	OP	63	91.9	30.6	17.7	9.6	12.9	9.6	....	54.8	19.3
	Not OP	134	95.5	47.4	33.3	17.7	13.3	11.8	82.9	18.5	5.9
	Total	197	94.4	42.1	28.4	15.2	13.1	11.1	56.8	29.9	10.1

but it is noted that when the duration of symptoms is long, pain is usually present. Absence or late occurrence of pain militates against early recognition.

Backache and Urinary Complaints.—Low backache, although not frequent (15.2 per cent), varied in incidence from 11.1 per cent in the adenomalignum I type to 20 per cent in the adenocarcinoma *B* type.

Urinary complaints, such as frequent and sometimes painful micturition, occurred in 13.1 per cent of the entire series. With the exception of the diffuse anaplastic type (13.3 per cent) the percentages for the other types were in proportion to the structural grading (absent in the adenomalignum I type and 25 per cent in the adenocarcinoma *B* type). Loss of weight was a late complaint; only 11.1 per cent gave this history.

From Chart IV it may be seen that all symptoms were more frequent in the group not operated upon. But the duration of symptoms before operation in the former group averaged 1.9 years, while the duration of symptoms before admission in the latter group averaged 1.8 years. The average time interval between operation and admission was 1.7 years. In the adenocarcinoma *A* type this interval was 2.8 years; in all other types it averaged from two to ten months.

Since the group not operated upon is the better for type comparisons in the relation of symptoms to admission, we will briefly discuss this group. The longest average duration was in the adenomalignum II type (2.3 years), with extremes of 18 years and 2 weeks. Of course such a long duration probably was caused by some complicating or preceding pathology. In the other types the average time varied from 1.1 years in the diffuse anaplastic type, or 1.7 years in the adenocarcinoma *A* type.

CHART V.—RELATION OF SYMPTOMS TO MENOPAUSE, OPERATION, AND ADMISSION

	Operated on or Not Operated on	No. Cases in Each Group	No. of Cases Symptoms Began after Menopause	Average Interval of Symptoms after Menopause (yr.)	Longest Interval after Menopause	Shortest Interval after Menopause	Average Time Symptom before Operation	Longest Time Symptom before Operation	Shortest Time (Month) Symptom before Operation	Average Time Operation before Admission	Longest Time Operation before Admission	Shortest Time Operation before Admission	Average Time Symptom before Admission	Longest Time Symptom before Admission	Shortest Time Symptom before Admission
Adenomalignum I	OP	4	2	9.	16.	2.	2.	4.	2 mo.	6 mo.	1.	2 mo.	2.5	5.	8 mo.
	Not OP	5	5	11.4	17.	4.	...	..	...	....	....	...	1.12	4.	2 mo.
	Total	9	7	10.7	17.	2.	...	..	...	....	....	...	1.7	5.	2 mo.
Adenomalignum II	OP	23	17	10.5	23.	1 mo.	1.7	7.	3 mo.	10 mo.	4.	1 mo.	2.6	7.1	8 mo.
	Not OP	53	46	13.1	39.	2 mo.	...	..	...	....	....	...	2.3	18.	2 wk.
	Total	76	63	12.3	39.	1 mo.	...	..	...	....	....	...	2.4	18.	2 wk.
Adenocarcinoma *A*	OP	29	13	10.8	25.	8 mo.	2.4	10.	1 mo.	2.8	21.	1 mo.	5.1	21.	2 mo.
	Not OP	46	29	11.7	30.	12 mo.	...	..	...	....	....	....	1.7	15.	1 mo.
	Total	75	42	11.4	30.	8 mo.	...	..	...	....	....	...	3.	21.	1 mo.
Adenocarcinoma *B*	OP	3	...	....	...	....	1.2	2.	4 mo.	10 mo.	1.2	5 mo.	1.4	3.2	9 mo.
	Not OP	17	14	12.8	28.	1.	...	..	...	....	....	...	1.6	9.	2 mo.
	Total	20	14	12.8	28.	1.	...	..	...	....	....	...	1.5	9	2 mo.
Diffuse Anaplastic Carcinoma	OP	4	3	5.6	10.	3.	8 mo.	2.5	3 mo.	2 mo.	5 mo.	1 mo.	1.1	2.6	4 mo.
	Not OP	11	9	12.2	25.	3.	...	..	...	....	....	...	1.2	6.	2 mo.
	Total	15	12	10.5	...	....	...	..	...	....	....	...	1.1	6.	2 mo.
Adeno-acanthoma	OP	...	...	....	...	....	...	..	...	....	....	...	....	..	...
	Not OP	2	2	17.5	25.	10.	...	..	...	....	....	...	7 mo.	1.	2 mo.
	Total	2	2	17.5	...	....	...	..	...	....	....	...	7 mo.	1.	2 mo.
Summary	OP	62	35	10.1	25.	1 mo.	1.9	10.	1 mo.	1.7	21.	1 mo.	3.6	21.	2 mo.
	Not OP	135	105	12.6	39.	2 mo.	...	..	...	....	....	...	1.8	18.	2 wk.
	Total	197	140	11.9	...	....	...	..	...	....	....	...	2.4	...	...

In 71 per cent of all cases the symptoms began after the menopause. The average interval was 11.9 years, with extremes of 39 years and 2 months (both adenomalignum II cases). Fifty-six per cent of the adenocarcinoma *A* cases began before menopause. This figure, combined with a corresponding one for the adenocarcinoma *B* type, makes a percentage of 58.9 of cases in which symptoms began before onset of menopause. This signifies that more adenocarcinoma cases occur before the menopause than any of the other types.

The relationship of the duration of symptoms to prognosis is entirely inconsistent. Chart VI shows that, of those patients who lived three or more years, 28.5 per cent had symptoms less than 6 months before admission; 22.8 per cent were between 7 and 12 months, and 48.8 per cent were longer than 12 months. From a different viewpoint we find that of those patients whose complaints were less than six months before admission, 39.2 per cent lived three or more years. Of those whose symptoms were between 7 and 12 months' duration,

CHART VI.—RELATION OF DURATION OF SYMPTOMS TO LENGTH OF LIFE (THREE OR FIVE YEARS)

Type	Operated on, Not Operated on	Duration of Symptoms															
		6 Mo. or less			7 to 12 Mo.			More than 12 Mo.			6 Mo. or Less			7 to 12 Mo.			More than 12 Mo.		
		No. Cases	No. Lived 3 Years or More	Percentage Lived 3 Years or More	No. Cases	No. Lived 3 Years or More	Percentage Lived 3 Years or More	No. Cases	No. Lived 3 Years or More	Percentage Lived 3 Years or More	No. Cases	No. Lived 5 Years or More	Percentage Lived 5 Years or More	No. Cases	No. Lived 5 Years or More	Percentage Lived 5 Years or More	No. Cases	No. Lived 5 Years or More	Percentage Lived 5 Years or More
Adenomalignum I	OP	..	..	.....	1	1	100	3	1	33.3	..	..	....	1	..	.....	3	..	.....
	Not OP	2	2	100.	1	..	.....	2	1	50.	2	..	....	1	..	.....	2	1	50.
	Total	2	2	100.	2	1	50.	5	2	40.	2	..	....	2	..	.....	5	1	20.
Adenomalignum II	OP	..	..	.....	2	1	50.	20	7	35.	..	..	....	2	..	.....	20	5	25.
	Not OP	20	11	55.	10	6	60.	24	13	54.1	20	7	35.	10	4	40.	24	9	37.5
	Total	20	11	55.	12	7	58.3	44	20	45.4	20	7	35.	12	4	33.3	44	14	31.8
Adenocarcinoma *A*	OP	2	1	50.	3	1	33.3	24	5	20.8	2	1	50.	3	..	.....	24	2	8.3
	Not OP	11	4	36.3	16	4	25.	19	5	26.3	11	3	27.2	16	1	6.2	19	4	21.
	Total	13	5	38.4	19	5	26.3	43	10	23.2	13	4	30.7	19	1	5.2	43	6	13.9
Adenocarcinoma *B*	OP	1	..	.....	1	..	.....	1	1	100.	1	..	....	1	..	.....	1	1	100.
	Not OP	7	1	14.2	5	..	.....	5	..	.....	7	..	....	5	..	.....	5	..	.....
	Total	8	1	12.5	6	..	.....	6	1	16.6	8	..	....	6	..	.....	6	1	16.6
Diffuse Anaplastic Carcinoma	OP	1	..	.....	2	..	.....	1	1	100.	1	..	....	2	..	.....	1	..	.....
	Not OP	6	1	16.6	3	1	33.3	2	..	.....	6	..	....	3	1	33.3	2	..	.....
	Total	7	1	14.2	5	1	20.	3	1	33.3	7	..	....	5	1	20.	3	..	.....
Adeno-acanthoma	OP	..	..	.....	..	..	.....	...	..	.....	..	..	....	..	..	.....	...	..	.....
	Not OP	1	..	.....	1	1	100.	...	..	.....	1	..	....	1	1	100.	...	..	.....
	Total	1	..	.....	1	1	100.	...	..	.....	1	..	....	1	1	100.	...	..	.....
Summary	OP	4	1	25.	9	3	33.3	49	15	30.6	4	1	25.	9	..	.....	49	8	16.3
	Not OP	47	19	40.4	36	13	36.1	52	19	36.5	47	10	21.2	36	7	19.4	52	14	26.9
	Total	51	20	39.2	45	16	35.5	101	34	33.	51	11	21.5	45	7	15.5	101	22	21.7

Fig. 9-*A*.

Fig. 9-*B*.

Fig. 10.

Fig. 9. Adenocarcinoma *B*. Case No. 15,914, admitted May 9, 1932, 67 years of age. Married; five normal pregnancies, one abortion; menopause at 36; bloody discharge for past three years; cervix hard; tumor mass in pelvis. Treatment: high voltage x-ray and radium tubes, two courses. The patient died on Jan. 9, 1934. Entire pelvis was infiltrated (two photomicrographs).

Fig. 10. Adenocarcinoma *B*. Case No. 16,743, admitted Oct. 3, 1932, 64 years of age. This section shows anaplastic cells grouped about a blood vessel. Married; two normal pregnancies; menopause at 54; irregular periods of bleeding began nine years ago; past six months has had pains in lower abdomen; uterus enlarged and hard. Treatment: high voltage x-ray, two complete courses and two incomplete courses, combined with radium tubes. The patient is alive—pelvis infiltrated.

35.5 per cent lived three or more years. Of those whose symptoms were longer than 1 year, 33 per cent lived three or more years.

Analyzing those cases which survived five or more years, it is found that 27.2 per cent had symptoms less than 6 months before admission, 17.5 per cent had symptoms between 7 and 12 months, and 55 per cent had symptoms over one year before admission. But of the number of cases which symptoms began less than 6 months, 7 to 12 months, or over 1 year before admission, the percentages of those living over five years are 21.5 per cent, 15.5 per cent, and 21.7 per cent, respectively.

A study of the separate types discloses no constant relationship between duration of symptoms and prognosis. In each period there is a definite decrease in life expectancy, directly as the loss of structural differentiation.

Signs.—Many patients with corpus cancer may have negative pelvic findings. Often the uterus is but little enlarged. Hertzler (12) found it to be quite commonly smaller than the parous uterus. He states, "If the tumor begins before involution has occurred the uterus may be larger than the parous uterus."

Of the cases not operated upon before admission, the percentage in which the uterus was enlarged was 82.9. Corresponding figures for the separate types are:

Adenomalignum I	— 100 %
Adenomalignum II	— 74%
Adenocarcinoma *A*	— 89.1%
Adenocarcinoma *B*	— 94.1%
Diffuse Anaplastic Carcinoma	— 81.8%

It can be seen that these statistics bear no significance as far as relationship between the pathologic type and the size of the uterus.

On admission, 29.9 per cent had extrauterine masses in the pelvis. These were either in the fornices, cul-de-sac, or both. It signifies metastasis, although an occasional case may have been due to fibromyomas, old pelvic infections with adhesions, etc.

This clinical sign was most frequent in the cases which had been operated upon (54.8 per cent). The percentage for the group not operated upon was 18.5. It is interesting to note that the incidence decreases as the degree of histologic differentiation increases, with the exception of the adenomalignum I type, in which case the percentage incidence was slightly higher than the adenomalignum II type.

It is significant to record the number in

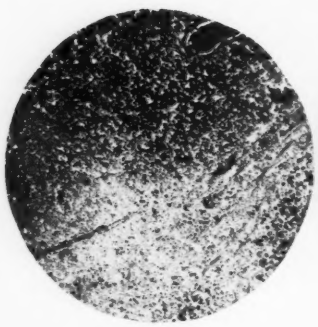

Fig. 11.

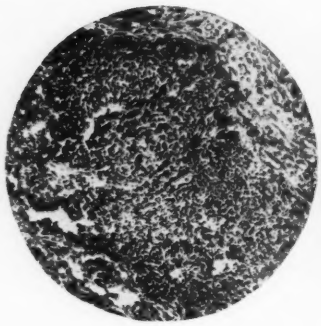

Fig. 12.

Fig. 13.

Fig. 11. Anaplastic carcinoma. Case No. 16,513, admitted Aug. 24, 1932, 59 years of age. Married; seven normal pregnancies, six abortions; past six years, menorrhagia; past four months, no bleeding until five days ago; uterus enlarged; cervix hard and nodular; large pelvic tumor mass. Treatment: high voltage x-ray, radium tubes, radon seeds, one course. The patient died on Oct. 30, 1932.

Fig. 12. Diffuse anaplastic carcinoma. Case No. 17,039, admitted Nov. 21, 1932, 59 years of age. Married; eight normal pregnancies, two abortions; menopause at 55. Six months before a supravaginal hysterectomy was done (Sept. 23, 1932); the patient began to bleed. Abdomen enlarged; cervix small. Treatment: high voltage x-ray, 3 courses. Radon seeds, two courses. The patient died on Dec. 16, 1933. Pelvis was infiltrated.

Fig. 13. Adeno-acanthoma. Case No. 12,261, admitted Sept. 10, 1929, 59 years of age. Married; no pregnancies; menopause at 48; one year past, constant bleeding; uterus normal size; cervix smooth. Treatment: high voltage x-ray before admission, one course. High voltage x-ray after admission; also radon tubes, one course. The patient is alive and well.

each type and the percentage who are alive with the average duration of life.

Type	No. of Cases with Mass in Pelvis	No. Alive	Percentage Alive	Average Duration of Life
Adenomalignum I	2	1	50.	3 yr. 8 mo.
Adenomalignum II	14	4	28.5	3 yr. 1 mo.
Adenocarcinoma *A*	28	5	17.8	2 yr. 9 mo.
Adenocarcinoma *B*	8	1	12.5	2 yr. 3 mo.
Diffuse Anaplastic Carcinoma	7	0	0	0

One can see some relationship between this clinical finding, the pathologic type, and the prognosis.

Vaginal wall metastasis occurred in 10.1 per cent of all cases. This incidence was highest in the operated group (19.3 per cent). The diffuse anaplastic type leads with 20 per cent, while the adenocarcinoma *B* type had only 5 per cent. Only two cases are alive who were admitted with vaginal wall metastasis; both are adenomalignum II types and had had hysterectomies before admission. One is alive five years without evidence of recurrence and the other is alive one year 10 months with pelvic recurrence. None of those who are dead lived five years.

TREATMENT

Every case was treated by irradiation (197 cases). Sixty-two had had hysterectomies performed before irradiation was started. It is not within the power of this paper to evaluate the quality of the surgical procedures followed, as the operations were done before the patients were referred to the Institute. It is safe to say, however, that from the descriptions of the technic submitted, extirpation of the uterine body was adequate. Seventeen were panhysterectomies. The rest were supravaginal amputation.

Irradiation therapy was carried out by means of x-ray and radium, separately or in combination.

X-ray.—High voltage x-ray has been used. The factors are as follows: volts, 200,000; milliamperes, 30; distance, 80 centimeters; angle, 90 degrees; field size, 20 × 25 centimeters; filter, copper, 0.5 millimeter, aluminum, 1.0 millimeter; effective wave length, 0.16 Ångstrom unit.

The tumor dose was computed from the patient's pelvic measurements by means of isodose charts. Cross-fire through two portals, anterior and posterior, in divided amounts sufficient to produce a skin erythema, which in this Institute represents 800 roentgens (air scattering) and 1130 roentgens (tissue scattering), was used. The course often was repeated in two months if the patient's condition warranted. As many as five complete and three incomplete courses have been given to one patient over a period of three years.

Radium Packs.—Radium packs prior to 1931 were used at 6 centimeters' distance, with a filter of 2 millimeters of brass, 0.5 millimeter of silver, 1 millimeter of aluminum, and 1 centimeter of rubber.

CHART VII.—CASES OPERATED UPON. END-RESULTS WHEN ADMITTED WITH OR WITHOUT RECURRENCE

	Three-year		Five-year	
	Recurrence	No Recurrence	Recurrence	No Recurrence
No. Cases	33	14	25	6
Percentage of Cures	24.2	42.8	16	33.3
Percentage of Survivals	27.2	78.5	24	66.6

CHART VIII.—PERCENTAGE OF PATIENTS LIVING THREE OR FIVE YEARS AFTER ADMISSION AND FREE OF ANY APPARENT PATHOLOGY

Type	Operated on, Not Operated on Total	No. Cases Admitted up until April 1, 1932	Percentage Living 3 or More Years Free of Pathology	Percentage Living 3 or More Years with or without Path.	No. Cases Admitted up until April 1, 1930	Percentage Living 5 or More Years Free of Pathology	Percentage Living 5 or More Years with or without Path.
Adenomalignum I	OP	3	66.6	66.6	...	.....	.....
	Not OP	5	40.	40.	4	25.	25.
	Total	8	50.	50.	4	25.	25.
Adenomalignum II	OP	12	58.3	66.6	10	50.	50.
	Not OP	43	39.5	62.7	33	39.3	54.5
	Total	55	43.6	63.6	43	41.8	53.4
Adenocarcinoma *A*	OP	24	12.5	29.1	14	.....	21.4
	Not OP	34	17.6	38.2	24	20.8	29.1
	Total	58	15.5	34.4	38	13.1	26.3
Adenocarcinoma *B*	OP	3	....	33.3	3	.....	33.3
	Not OP	11	....	9.	8	.....	.....
	Total	14	....	14.2	11	.....	9.
Diffuse Anaplastic Carcinoma	OP	2	50.	50.	1	.....	.....
	Not OP	9	22.2	22.2	7	14.2	14.2
	Total	11	27.2	27.2	8	12.5	12.5
Adeno-acanthoma	OP	...	....	....	...	.....	.....
	Not OP	2	50.	50.	1	100.	100.
	Total	2	50.	50.	1	100.	100.
Summary	OP	44	29.5	43.1	28	17.8	32.1
	Not OP	104	23.	44.2	77	27.2	36.3
	Total	148	27.7	43.9	105	24.7	35.2

The size of the field was 6.5 × 7.5 centimeters through two or three portals, anterior and posterior, and sometimes perineal.

Since 1931, the four-gram radium element pack has been used. When two fields, anterior and posterior, were used at 10 centimeters distance, dimensions of field

CHART IX.—COMPARISON OF THREE AND FIVE-YEAR END-RESULTS OF THE GROUP OPERATED ON WITH THE OPERABLE AND INOPERABLE CASES OF THE GROUP NOT OPERATED ON

Type	Operated on, Not Operated but Operable Inoperable	Three-year Group			Five-year Group		
		No. Cases in Each Group	Percentage 3-year Apparent Cures	Percentage 3-year Survivals	No. Cases in Each Group	Percentage 5-year Apparent Cures	Percentage 5-year Survivals
Adenomalignum I	OP	3	66.6	66.6	..	.....	.....
	Not OP Operable	4	50.	75.	3	33.3	33.3
	Not OP Inoperable	1	.....	.....	1	.....	.....
Adenomalignum II	OP	12	58.3	66.6	10	50.	50.
	Not OP Operable	35	48.5	71.4	27	48.1	62.9
	Not OP Inoperable	8	.....	25.	6	.....	16.6
Adenocarcinoma *A*	OP	24	12.5	29.1	14	.....	21.4
	Not OP Operable	27	25.9	40.7	21	28.5	28.5
	Not OP Inoperable	7	.....	28.5	3	.....	33.3
Adenocarcinoma *B*	OP	3	.....	33.3	3	.....	33.3
	Not OP Operable	5	.....	20.	3	.....	.....
	Not OP Inoperable	6	.....	.....	5	.....	.....
Diffuse Anaplastic Carcinoma	OP	2	50.	50.	1	.....	.....
	Not OP Operable	3	33.3	33.3	3	33.3	33.3
	Not OP Inoperable	6	16.6	16.6	4	.....	.....
Adeno-acanthoma	OP	..	.....	.....	..	.....	.....
	Not OP Operable	1	100.	100.	1	100.	100.
	Not OP Inoperable	1	.....	.....	..	.....	.....
Summary	OP	43	30.2	44.1	27	18.5	33.3
	Not OP Operable	75	37.3	56.	58	39.6	44.8
	Not OP Inoperable	29	3.4	17.2	19	.....	10.5

size were 20.5 × 20.5 centimeters. Occasionally two anterior, two posterior, and one perineal field were used at 10 centimeters distance. Here the field size was 10 × 10 centimeters. Filter was 1.0 millimeter of platinum, 1.5 millimeters of steel, with a secondary filter next to the skin of 0.5 millimeter of copper and 1 millimeter of aluminum. The dose has been as high as 210,000 milligram-hours, divided up over 13 days in two fields, anterior and posterior.

Intracavitary Radium.—Before 1931, radium emanation was used in two 50 millicurie tubes, placed in tandem into the cavity of the uterus. Dose varied from 1,200 to 2,400 millicurie-hours. Filter was 0.5 millimeter gold, 0.5 millimeter brass, and 1 millimeter rubber. Since 1931, radium element has been used in a 100 milligram tube. Filter was 1 millimeter platinum and 1 millimeter aluminum: dose, from 1,200 to 2,400 milligram-hours.

Interstitial Radium.—In some cases radon seeds were placed into the cervix, especially in a case operated upon, where recurrence was present. Seeds were also used in vaginal wall metastases. The dose depended upon the size and extent of the lesion treated.

There was no particular indication for using x-ray instead of a radium pack as the source of external irradiation. Practically all cases received radium application locally in the uterus or vagina in addition to the external irradiation. Since each case upon admission was carefully examined and curettage or biopsy done whenever possible, each case received irradiation therapy according to its particular merits and in dosages which at the time seemed most sufficient.

RESULTS

In the five-year group (108 cases admitted up until April 1, 1930) the percentage of apparent cures was 25, and the percentage of survivals with or without pathology was 35.1.

The percentage of five-year cures in the group not operated upon was 27.2, while the corresponding figure in the group operated upon was 19.3. The percentage of cases operated on which lived with or without pathology for five years was 32.2 compared to a percentage of 36.3 in the group not operated upon. Only five adenomalignum II cases and one adenocarcinoma case *A* had cures from cases operated upon in this five-year group.

The patients of the group not operated upon who were in an operable state on admission gave 39.6 per cent cures, while the cases operated on gave 19.3 per cent cures.

When extra-uterine extension had taken place in the group not operated upon, not one case was cured and only two cases (one adenomalignum II and one adenocarcinoma *A*) lived with pathology for five years.

Of the 10 cases operated on who did live five years, six showed evidence of recurrence on admission. Of these six, four gave apparent five-year cures (three adenomalignum II cases and one adenocarcinoma *A* case). The time interval between operation and irradiation was less than five months in the adenomalignum II cases, and three years in the adenocarcinoma *A* case. Of those four cases which were not cured but lived over five years, the time intervals between operation and irradiation were three years, seven months, one year, seven months, one month, and one year, three months. The first three (adenocarcinoma *A* cases) showed recurrence on admission while the last two (one adenocarcinoma *A* and one adenocarcinoma *B*) had no evidence of recurrence on admission but subsequently developed recurrence.

Analyzing those 21 cases operated on which did not live five years, it is found that all but two showed evidence of recurrence on admission. One, which was admitted four months after operation, died due to cardiac disease, but was free of recurrence; and the second, admitted one month after operation, died of recurrence in two years, nine months.

In those cases operated on which were admitted with recurrence and did not live five years, the time interval between operation and irradiation was as follows: less

than 6 months, nine cases; seven to 12 months, three cases; one to two years, four cases; over two years, three cases.

Thus it is seen that of 25 cases operated on which showed evidence of recurrence on admission, the percentage of five-year cures was 16. Of the six cases operated on which were free of recurrence on admission, the percentage of five-year cures was 33.3. It should be stated, however, that several of these cases had recurrence in a cervical stump where radium applications were easily applied.

Charts VIII and IX will show the relative results in the separate pathologic types. Best end-results were in the adenomalignum types where operation, if attempted, should be confined.

A study of a three-year group consisting of 151 cases, admitted up until April 1, 1932, revealed comparable summarized results. Individual types varied, as seen in Charts VIII and IX. No definite conclusions shall be drawn from this group because of the short time period.

CONCLUSIONS

The clinical history of many patients reveals that a functional abnormality exists in the reproductive apparatus.

The end-results of this series of cases at least demonstrates what irradiation *per se* will do. Every patient should have a diagnostic curettage to determine the histologic type. If hysterectomy is performed, it is best confined to the adenomalignum types and should be total. Irradiation should closely follow operation. It is safe to say that pre-operative irradiation would greatly enhance post-operative results.

The future should witness much better end-results from irradiation alone because of the newer technic of daily fractional protraction of x-rays and more adequate distribution of radium applications *in situ*.

The curability of uterine corpus cancer has not depended as much upon any peculiar sensitivity of the individual type to irradiation as it has upon the reactionary power of the host to this irradiation, the integrity of the myometrium, and the accessibility of the neoplasm to the curet and radium applications.

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IRRADIATION TREATMENT IN CARCINOMA OF THE UTERUS[1]

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BETWEEN the years of 1921 and 1934, together with Dr. Soiland (1921–1925) and Dr. Soiland and Dr. Meland (1926–1934), we have treated 1,143 cases of carcinoma of the uterus by irradiation methods. Of this group, 718 were primary carcinomas of the cervix, 183 were carcinomas of the cervix treated post-operatively, 105 were primary carcinomas of the fundus, 68 were carcinomas of the fundus treated post-operatively, and 69 were carcinomas occurring in the cervical stump, following a previous subtotal hysterectomy. Cases of carcinoma of the uterus are not seen in the early stage of the disease. In our practice, early carcinomas of the cervix, which would fall into Group I of the Schmitz classification, were rare. In the treatment of carcinoma of the uterus, the big problem has always been the metastatic pelvic glands.

The Schmitz classification, as follows, was used:

Group I. The clearly localized carcinoma; beginning nodule.

Group II. The doubtfully localized carcinoma; beginning ulceration.

Group III. The invading carcinoma, parametrial involvement.

Group IV. The terminal carcinoma: (*a*) fixation; (*b*) involvement of adjacent organs; (*c*) distant metastasis.

The clinical grouping of the 718 cases of carcinoma of the cervix showed 5 per cent which would fall into Group I of the Schmitz classification, 24 per cent were in the Group II or doubtful early cases, and 71 per cent in Groups III and IV, with definite pelvic gland involvement.

Of the post-operative group of carcinomas of the cervix (183 cases), 81 per cent had evidence of definite recurrence when they first reported for irradiation treatment. It is interesting to note here that of the 183 post-operative cervical cases, 153 were seen between the years 1921 and 1930. In this era, and in this locality, much more surgery was being done for carcinoma of the cervix than during the past five years or at the present time.

CARCINOMA OF THE CERVICAL STUMP

The 69 cases of carcinoma of the cervical stump were approximately 6 per cent of the total of 1,143 cases of cancer of the uterus that were seen. Following previous supravaginal hysterectomy, the shortest time of appearance of carcinoma was two months and the longest time, twenty-three years. Fourteen cases developed carcinoma under one year after operation and 29 in less than two years after operation; these cases were probably pre-existing at the time of operation. The average time of recognition after operation was four and a half years. Fifty-two per cent of the cases had pelvic gland metastasis when first examined. In this group it is difficult to understand why there should be a larger number of cases in which the disease was localized or doubtfully localized to the cervix, than in the group of primary carcinomas of the cervix. Perhaps this variation is due to the fact that these patients, once having undergone surgery and having been assured they would be well, became early alarmed at the presence of bleeding or discharge from the cervical stump and returned promptly for examination.

Twenty-one of the 69 cases of carcinoma of the stump were seen during the five-year period, 1921 to 1925. Ten of these cases could not at the present time be traced, and are counted as dead, although two had survived five years and were well when last seen. The remainder of the 21 are definitely known to be dead. However, four of these cases have survived the ten-year period after treatment with irradiation, two cases having had palpable glands when first seen. Radium in the cervical canal

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and vaginal vault was the only treatment given in two cases. Two had a combination of x-ray and radium, but the amount of x-ray treatment given in those years was small and would be considered entirely inadequate now. Nevertheless, with this moderate amount of treatment we have four patients, with this unfavorable carcinomatous involvement, that have been well for a ten-year period.

It is seen that this group of cases is particularly unfavorable for irradiation treatment, especially with radium, due to the altered anatomic condition which causes the application of radium to be difficult. Of course, at the present time heavy external irradiation would be used almost exclusively in these cases.

The saddest feature about this group is that carcinoma undoubtedly could have been prevented if the cervix had been removed at the time of the supravaginal hysterectomy.

PATHOLOGY

Prior to 1931, our cases were not graded pathologically as to the degree of malignancy. Since that time, Dr. Ludwig Lindberg has been associated with us and all cases have been graded. It has been found that the large majority of cases of carcinoma of the cervix fall into Grades III and IV, Broders classification (about 80 per cent). A group of 231 cases of carcinoma of the uterus have been graded in our office since 1931, as shown by Table I. A number of other cases treated by us in other hospitals were not graded.

TABLE I.

	Grade I (Broders)	Grade II	Grade III	Grade IV
Squamous Carcinoma Cervix, 176 cases	0	19%	58%	23%
Adenocarcinoma Cervix, 20 cases	20%	30%	45%	5%
Adenocarcinoma Fundus, 35 cases	34%	29%	26%	11%

DEVELOPMENT AND METHODS OF TREATMENT

In the cases treated in 1921, and some in the following few years, only radium was used. Some of these cases, even with metastatic pelvic glands, showed complete disappearance of the disease after treatment with radium alone. In 1922, deep therapy was commenced with voltages between 180 and 200 kilovolts. From then on, the great majority of all cases of carcinoma of the uterus received both radium and deep x-ray therapy. As time progressed, more intensive x-ray treatment has been administered, and in recent years fractionated doses have been given. During the past two years voltages of around 500 kilovolts have been used.

PRESENT TECHNIC

Since 1933, in our present technic, a voltage of around a half million is used with the Lauritsen type tube—distance 52 cm.; filter 0.6 mm. lead (equivalent 12 mm. or $^1/_2$ inch copper); effective wave length 0.05 Ångstrom; half value layer 0.5 mm. lead; in aluminum, half value layer 23 mm. aluminum; depth dose 53 per cent at 10 cm. (in paraffin). Treatment rate is 15 r per minute. Four or six pelvic portals are used; two 15 × 15 cm. portals anteriorly over the pelvis; two 15 × 15 portals posteriorly, and two laterally, if six portals are used. Daily, two portals receive 150 r units (measured in air); total dosage of from 1,600 to 2,000 r is given each portal. This produces a definite erythema, with desquamation. Diarrhea is complained of in many cases but usually soon disappears if the daily dosage is decreased. In some cases 300 r is given daily, alternating the four or six portals. With safety, from 10,000 to 12,000 r units may be given over a period of from five to six weeks. The plan of this treatment should be individualized considerably, according to the size of the patients and their ability to withstand the irradiation.

The primary growth is markedly influenced by the x-ray series. Often, a cauliflower primary growth of a high degree of malignancy will completely disappear after such a series.

Following the x-ray series, radium applications are commenced *immediately*, a divided series of vaginal and intra-uterine applications being given. In the vaginal application, 2 mm. of gold and 1 mm. of aluminum filter is used, and in the intra-uterine application, 1 mm. of gold and 1 mm. of aluminum is used. Previously, we applied a vaginal dosage of from 1,200 to 1,400 milligram-hours, and an intra-uterine dosage of from 900 to 1,200 milligram-hours. This was repeated in one week and again in two weeks. Since the supervoltage x-ray has been used, we have reduced the vaginal vault dosage, but have not eliminated it. Usually, however, most of the radium dosage is given intra-uterine. With 1 mm. gold filter, a dosage of from 4,000 to 6,000 milligram-hours may be given. This dosage is divided into one- and two-week intervals. Many cases which have had the full radium dosage have not shown any bad effects following this heavy irradiation. The fact that the radium follows immediately after the x-ray series is probably the important factor in preventing unduly delayed reactions, because the tissues in the vaginal vault and cervix have not had time to develop fibrosis and interference with the local circulation, which occurs from four to six weeks following intensive irradiation.

Certainly, the intra-uterine radium can do no harm to the bladder or rectum, as distance and filtration prevent much irradiation outside of the walls of the uterus. We believe the radium dosage absolutely essential in order to give sufficient irradiation to the uterine canal and cervical glands.

RESULTS

Carcinoma of the Cervix.—In the group of cases, during the period from 1921 to 1925, a total of 209 cases were seen; 15 were not treated and 34 (16.2 per cent) were untraced. Fifteen cases (7.1 per cent) have lived past the ten-year period and are free from disease at the present time. Some have died of other causes than cancer, but are grouped with the cases that have died of cancer as are our untraced cases, which form such a large percentage of the total. Of the cases living, three were in the clinical Group I, seven in Group II, four in Group III, and one in Group IV. We realize that the percentage of ten-year cures here reported is low, but considering that 70 per cent of the cervix cases had pelvic gland involvement when first seen, and that facilities for external irradiation were not adequate at that time, the 15 patients living ten years and longer give definite proof of the value even of a limited amount of irradiation.

Post-operative Carcinoma of Cervix.—In the period from 1921 to 1925, 90 cases were seen. These cases were referred by a variety of operators, many of whom had apparently undertaken to do a simple total hysterectomy in cases which already had parametrial infiltration. When first referred for irradiation, 68 per cent of these had palpable definite recurrences. Only six have remained well after the ten-year period.

In 34 cases of carcinoma of the fundus, treated during the same period of time, 14.7 per cent are well after ten years. In this early period, 25 cases of carcinoma of the fundus were treated by surgery followed by irradiation. These were deemed to be operable by the surgeon, and radical hysterectomy was done, followed later by irradiation. Only one of these cases survived the ten-year period.

Twenty-one cases of carcinoma of the cervical stump were treated during the period from 1921 to 1925; 19 per cent are well after ten years.

As mentioned before, radium alone was used in the great majority of these cases; also, the maximum filtration of the radium was 1 mm. of brass. Consequently, the radium dosage was only about one-half that which is generally applied to-day.

In the period from 1926 to 1930, the amount of primary regression, palliation,

and the percentages of cures increased. The five-year result in this group (298 cases of primary carcinomas of the cervix), including cases not treated and those untraced, is 19.5 per cent absolute five-year cures. The percentage of advanced cases was practically the same in this group but the use of larger dosages of radium, with heavier filtration and the addition of more systematized 200 kv. x-ray technic, has improved the results. It is hoped, at a later time, to report these cases in detail, together with the later group (1931 to 1934).

SUPERVOLTAGE

Our experience in supervoltage extends over a five-year period, but the supervoltage work in our clinic has been carried on only a little over two years, and, of course, it is too early to have much conclusive information regarding the permanent curative effects of this measure. However, sufficient opportunity has been given to observe the effects of primary regression of the growth in a considerable number of cases of carcinoma of the cervix with metastatic pelvic glands. A few of these are briefly cited here.

It is realized that there is a great difference between primary regression of the tumor and five- or ten-year permanent cures. However, it has been observed that, in about half of these cases of Group III (Schmitz) which have not had previous irradiation, there is a complete disappearance of the palpable pelvic glands following the external supervoltage irradiation followed by radium. In 20 cases the time since treatment is past one year. Two cases with bilateral, fixed, parametrial involvement (Group IV, Schmitz) have shown complete disappearance of all palpable pathology.

We realize that primary regression and even five-year definite arrests of cases with pelvic glands have been obtained in the past by the use of voltages around 200 kv. with radium, and by Coutard without radium. In our experience, however, it seems that the primary regression has been more prompt and more certain from the use of the 500 kv. technic.

Some cases which had been given complete radium and 200 kv. x-ray technic, with only partial improvement, have later been cleared up of their pelvic gland pathology by the use of the 500 kv. technic. These cases were among the earlier ones treated with supervoltage at our clinic, and which received dosages much smaller than those employed at the present time.

Case 1. Mrs. M., squamous-cell carcinoma, Grade III, clinical Group III. In 1931, this patient was given radium(6,000 mg.-hr.) and x-ray, a total of 900 r units (200 kv.) over each of four pelvic fields. The growth which involved the cervix and vaginal vault disappeared. The extensive infiltration in the right parametrium did not change. Six months later, another fractionated series of 1,200 r to each of four 15 × 15 cm. pelvic fields over a period of three weeks was given without any definite palpable change. In June, 1933, this growth had extended, involving the rectovaginal septum, producing a mass 6 × 6 cm. in size, and partially occluding the rectum. At this time, the 500 kv. technic was used, with an attempt to cross-fire on the indurated area, 1,300 r being given through each of one 10 × 10 cm. perineal and two 15 × 15 cm. gluteal fields, over a period of 21 days. The infiltration entirely disappeared and has not recurred to the present date, an interval of about eighteen months. This amount of irradiation is certainly not a large one, but has so far proved sufficient in this case.

Case 2. Mrs. T., Grade IV squamous carcinoma, clinical Group III, with fixed right parametrial involvement. In October, 1932, the patient was given 6,400 milligram-hours of radium, and 4,000 r x-ray with 200 kv. (four pelvic fields, fractionating dosage, 25 days). There was local healing of cervix and vaginal vault involvement but no change in right parametrial involvement. The patient returned in May, 1934, with extensive fixed parametrial involvement on both right and left sides. A supervoltage series (500 kv.) was

then given over four pelvic portals, a total of only 3,800 r being given over a period of about three weeks. There was a complete disappearance of all parametrial infiltration, and there has been no recurrence after a period of 19 months.

Case 3. Mrs. P., squamous-cell carcinoma, Grade II, clinical Group IV, treated 17 months ago, vaginal vault contracted, cervix nodular, ulcerated and necrotic; bilateral, fixed infiltration of parametria. The patient was given radium, 4,600 mg.-hr.; supervoltage to five fields, one 10 × 10 cm. and four 15 × 15 cm., over pelvis, 1,500 r each. The total dosage of 7,500 r was fractionated over a period of 30 days. All pelvic pathology completely disappeared and there has been no recurrence during the past 17 months. The response in this case is striking, due to the low grade of the malignancy and the extent of the disease. We have not obtained a result similar to this with radium and 200 kv. x-rays in this grade of malignancy, and with this extent of disease.

SUMMARY

During the past 14 years, definite improvement has been made in the technic of irradiation of carcinoma of the uterus, both in the use of radium and x-ray. Even incomplete irradiation produces ten-year cures in early uterine carcinomas, as is shown by some of our group of 1,143 cases, during the period of 1921 to 1925, but will be of little benefit to those with pelvic gland metastasis. The use of intracavital radium is limited to the local pathology in the uterus, and very little permanent effect can be expected in the metastatic pelvic gland areas. Here, external irradiation by means of 200 kv. x-ray has been shown to be of value. The x-ray irradiation should be a thorough, fractionated, daily course, as has been outlined here, and followed by the immediate use of radium in the uterus. Supervoltage x-ray of 500 kv. or higher may prove to be a more efficient addition to the radium than the 200 kv. This supposition is based upon the primary regression so far obtained.

BENIGN PREPYLORIC ULCER[1]

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THERE has been a growing inclination in recent years to regard the terminal portion of the stomach as possessing distinctive physiologic characteristics, and pathologic tendencies. Thus, ulcers in this location are quite widely believed to be more often ulcerating carcinomas, or if benign, to show a higher incidence of malignant degeneration than lesser curvature ulcers in the pars media. While an exhaustive review of the literature does not come within the province of the present discussion, a few references to recent opinions on this question may be helpful.

Fig. 1.

Fig. 2.

Fig. 1. Case 1. Mr. G. B., aged 50 years. Benign prepyloric ulcer; note ulcer crater immediately proximal to pyloric sphincter. (See Table II.)

Fig. 2. Case 2. Mrs. A. S., aged 44 years. Multiple gastric ulcers; one prepyloric ulcer immediately proximal to the sphincter. On microscopic examination, both were benign, chronic gastric ulcers.

With regard to the development of cancer in gastric ulcers in general, the most widely divergent opinions have been, and still are, held, due partly at least to lack of unanimity among pathologists in the interpretation of early malignant changes in ulcer. The most commonly accepted incidence of cancer in gastric ulcer is from 5 to 10 per cent, with many writers placing the figure even lower than this. Ewing (1) states that "among the many ulcers treated medically which persist or recur, not more than 2 per cent develop cancer and some of these may have been originally cancers." However, the incidence of cancer in ulcers in the extreme pyloric end of the stomach, quoted by many recent observers, is definitely higher than this. Thus, Hurst (2) reports that "no less than three out of nine ulcers in the pyloric region showed malignant changes." Orator (3) found 11 out of 34 ulcers in the prepyloric region to show malignant changes; Haudek (4) is in agree-

[1] Presented before the Radiological Society of North America, at the Twenty-first Annual Meeting, in Detroit, Dec. 2-6, 1935.

TABLE I—DISTRIBUTION OF 145 CASES OF BENIGN GASTRIC ULCER

Total cases	145
Above prepyloric segment as defined	130 cases (or 90 per cent)
Benign prepyloric ulcer (all cases)	15 cases (or 10 per cent)
Benign prepyloric ulcer microscopically proven	7 cases (or 5 per cent)

ment with this figure. Kirklin (5) states that ulcers near the pylorus are more likely to be malignant than those on or near the lesser curvature and well removed from the pylorus. Hampton (6), limiting the prepyloric region to include only the distal one inch of the stomach exclusive of the sphincter, found not a single instance of chronic benign prepyloric ulcer in the Massachusetts General Hospital over a three-year period.

In order to determine the relative and actual frequency of benign and malignant ulceration in the prepyloric portion of the stomach, I have reviewed the films of all cases in which a diagnosis of gastric ulcer was made in the Department of Radiology of the Toronto General Hospital, since the first of January, 1932. This comprises a period of almost four years.

Without fully agreeing that the prepyloric segment should be so narrowly confined, it has been limited for the present study to include only the terminal one inch of the stomach. Ulcers in the sphincter have been excluded, as, surgically and pathologically, these are usually considered as duodenal ulcers. As the subject is mainly concerned with the differential diagnosis of benign and malignant ulceration, obvious large ulcerating carcinomas in the pyloric end of the stomach have been considered as carcinomas and not as ulcers. In any event, all the lesions so excluded involved more than the small prepyloric segment as defined.

In all cases of benign prepyloric ulcer here reported, in which the lesion was resected, the ulcer has been studied by serial microscopic sections, showing all portions of the ulcers. The actual location of the ulcers was determined by measurements on the radiographic films, and from the pathologists independent measurement of the ulcer as seen in the gross specimen, measuring from the center of the crater in each case.

In the four-year period since January, 1932, our records show 145 cases of benign gastric ulcer. Of these 145 cases, 15, or

TABLE II

Case	Sex	Age	Duration of Symptoms	Location of Ulcer	Path. Report
G. B. Case 1	M.	50	8 years	On lesser curvature 1.5 cm. above the proximal border of sphincter	Healing benign ulcer on lesser curve 1.5 cm. proximal to sphincter
A. S. Case 2	F.	44	3 years	On lesser curvature immediately proximal to sphincter	Benign ulcer 0.7 cm. diameter on lesser curve immediately proximal to pyloric sphincter
J. R. Case 3	M.	39	12 years	On lesser curvature 2.5 cm. proximal to sphincter	Benign ulcer 2.5 cm. proximal to sphincter
E. L. Case 4	F.	40	15 months	Immediately proximal to sphincter	Benign ulcer close to sphincter
J. McK. Case 5	M.	48	8 years	2.5 cm. proximal to sphincter	Benign ulcer 2.5 cm. proximal to sphincter
A. P. Case 6	M.	48	4 years	On lesser curvature immediately adjacent to pyloric ring	Immediately adjacent to pyloric ring, benign ulcer 0.5 × 0.7 cm. diameter
H. W. Case 7	F.	29	3 years	On lesser curvature 2 cm. proximal to sphincter	Chronic benign ulcer 2.5 cm. in diameter

Male 4 Youngest 29
Oldest 50
Female 3 Average 43 Average duration of symptons—five and one-half years

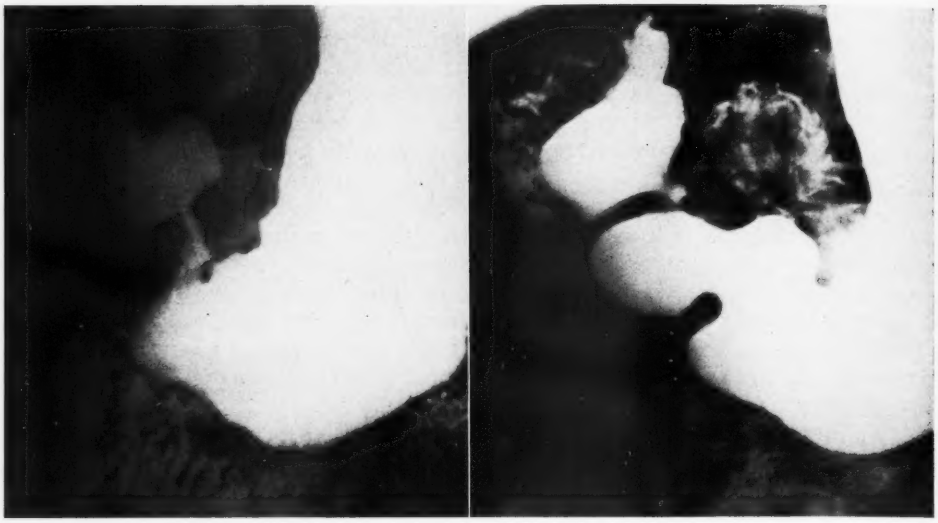

Fig. 3. Fig. 4.

Fig. 3. Case 3. Mr. J. R., aged 39 years. Benign prepyloric ulcer; note ulcer crater on lesser curvature 2.5 cm. proximal to the sphincter.
Fig. 4. Case 4. Mrs. E. L., aged 40 years. Benign prepyloric ulcer; note ulcer crater on lesser curvature immediately proximal to the sphincter.

10 per cent, involved the prepyloric segment, and 130, or 90 per cent, were above this region, on or near the lesser curvature. Of the 15 cases of ulcer in the prepyloric segment, seven had partial gastrectomy, and, microscopically, their lesions were found to be benign gastric ulcers within one inch of the sphincter in each case (see Table I).

Of the seven cases of proven benign prepyloric ulcer, four were men and three were women. The youngest patient was 29 years of age, the oldest was 50, and the average age was 43 years. The duration of clinical symptoms varied from fifteen months to twelve years, the average being five and one-half years. The location of the ulcer varied from immediately proximal to the sphincter to the limit of the area here considered, *i.e.*, one inch from the sphincter. The actual diameter of the ulcer craters varied from 3 millimeters to 2.5 centimeters. Without giving all the detail of the clinical features of these cases, their essential findings are shown in Table II, with a characteristic radiograph of each case shown in from Figures 1 to 7, respectively.

Of the eight cases which were not subjected to resection, each presented a clinical history quite compatible with ulcer; radiologically, each showed a well defined prepyloric crater, and each case had relief of symptoms and disappearance of the crater on medical treatment. Clinically, these cases have remained well, and have given negative radiologic findings over periods varying from a few months to three years.

In order to provide a comparison, the cases in the corresponding period of time presenting the radiologic findings of gastric cancer were reviewed with regard to the incidence of carcinoma in the pyloric end of the stomach, and as to the number that involved only the small prepyloric segment. This series comprised 133 cases of gastric cancer, of which 60 cases, or 45 per cent, involved the cardiac end or the pars media, and 73 cases, or 55 per cent, involved the pyloric end of the stomach. Of the 73 cases of pyloric end carcinoma, only

Fig. 5 Fig. 6

Fig. 5. Case 5. Mr. J. McK., aged 48 years. Benign prepyloric ulcer 2.5 cm. proximal to the sphincter. The ulcer is associated with intense spasm of the prepyloric segment.

Fig. 6. Case 6. Mr. A. P., aged 48 years. Benign prepyloric ulcer; note large crater on lesser curvature just proximal to the sphincter. In this case the ulcer had become very much smaller between the making of this film and the resection, so that it was only 0.5 × 0.7 cm. in diameter in the resected specimen.

13 cases, or 10 per cent of the total, involved only the small prepyloric segment of the stomach, as here defined. These 13 cases include four malignant prepyloric ulcers (see Table III).

The four cases of malignant ulcer in the prepyloric segment, while too few to allow of definite conclusions, presented the following findings. There were three men and one woman in this group, the youngest patient being 49 years of age, the oldest, 67, and the average age, 53. The shortest history of gastric symptoms was six months—the longest 15 years. In two of the four cases, the microscopic examination suggested development of the carcinoma in chronic benign ulcer (see Fig. 8).

If one takes from both series of cases all those showing evidence of ulcer within one inch of the proximal border of the sphincter, it is observed that of 19 cases, 15 are benign, if clinical and radiologic evidence alone is accepted. Of 11 cases in which microscopic examination of the lesion was obtained, seven were found to be benign as compared to four with carcinomas (see Table IV). As to the accuracy of radiologic interpretation in the seven cases of benign prepyloric ulcer operated upon, in four, the pre-operative diagnosis was benign ulcer, while in the other three cases we felt that in all probability the lesion was benign ulcer, but because of insufficient response to medical treatment and the

TABLE III.—DISTRIBUTION OF 133 CASES OF GASTRIC CANCER

Total cases	133
Cardiac end and pars media	60 cases (or 45 per cent)
Pyloric end	73 cases (or 55 per cent)
Prepyloric segment only	13 cases (or 10 per cent)
Malignant prepyloric ulcer (included in the 13 cases in the prepyloric segment)	4 cases (or 3 per cent)

TABLE IV.—RELATIVE INCIDENCE OF BENIGN AND MALIGNANT PREPYLORIC ULCER

Total cases	19
Benign	15 cases (or 79 per cent)
Malignant	4 cases (or 21 per cent)
Benign (microscopically) proven	7 cases (or 37 per cent)

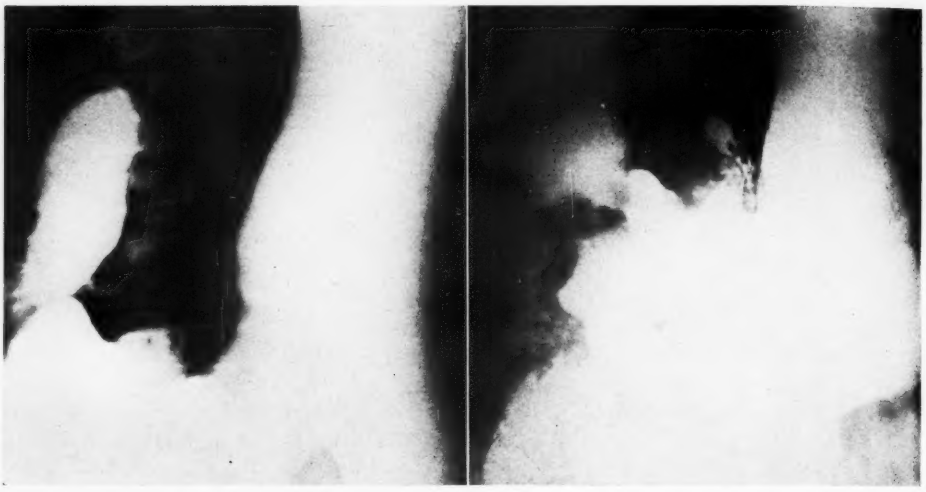

Fig. 7. Fig. 8.

Fig. 7. Case 7. Mrs. H. W., aged 29 years. Large benign prepyloric ulcer; note crater on lesser curvature about 2.5 cm. proximal to the sphincter. The ulcer crater measures 2.5 cm. in diameter.

Fig. 8. Mrs. M. G., aged 59 years. Ulcerating prepyloric carcinoma (malignant prepyloric ulcer). Note deep crater with overhanging edges. On fluoroscopic examination, this lesion was associated with a definite palpable mass.

quoted high incidence of malignant degeneration in prepyloric ulcers, we felt that we could not exclude carcinomatous ulcer. Of the four cases classified as malignant prepyloric ulcer, three had pre-operative radiologic diagnosis of gastric cancer. The fourth case was diagnosed benign and, microscopically, showed carcinoma developing in benign chronic ulcer.

Radiological Findings in Benign Prepyloric Ulcers.—The ease of demonstration of prepyloric ulcers varies with the position and depth of the crater and the degree of associated spasm. In many cases, particularly in superficial ulceration, the amount of spasm is out of all proportion to the size of the ulcer causing it, and may even mask the crater or simulate an annular infiltrative lesion. In deeper, more penetrating types of ulcer, spasm is usually less or may even be absent. The crater itself usually presents a square or conical appearance, being widest at its junction with gastric lumen, as are benign ulcer craters elsewhere. A flattening of the lesser curvature immediately proximal to the sphincter is not uncommon, and one may be able to visualize the crater of a small mucosal ulcer in the center of the flattened area. If the spasm is great, the gastric rugæ are compressed and may not be satisfactorily visualized. In cases in which spasm is not marked, one may visualize a convergence of gastric rugæ toward the lesion. Gastric peristalsis is usually normal or hyperactive in these cases, in spite of which a six-hour residue is relatively common. Four of our seven microscopically proven cases of benign ulcer gave six-hour residues, varying from 20 to 90 per cent. The fluoroscopic examination is of extreme importance, as in these cases one will seldom, if ever, be able to palpate a mass associated with the lesion.

The accurate localizing of an ulcer with regard to the pyloric sphincter is of prime importance but may be difficult in certain cases. If one can place the crater as distal to the sphincter, the question of carcinoma may, of course, be dismissed.

In contrast to the above description of benign prepyloric ulcer, the malignant ulcer usually presents more clean-cut features. The ulcer itself is usually larger in diameter and deeper, and is more often

found on the posterior wall of the prepyloric segment The edges of the crater are frequently heaped up, giving the appearance of a pocket with a narrower communication with the lumen of the stomach. On palpation under the fluoroscope, the halo sign of Carman (7) or the meniscus sign may frequently be demonstrated. If good relaxation of the patient's abdominal muscle is obtained by examining in the semi-recumbent position, a mass corresponding to the ulcer will usually be felt. The lesion practically always produces some degree of pyloric obstruction, as indicated by a six-hour gastric residue (Fig. 8).

In the differential diagnosis of benign and malignant prepyloric ulcer, and of prepyloric lesions generally, we have found a repeat examination, after the patient has been for from two to three weeks on a bland diet, to be of inestimable value and we have adopted this procedure in all doubtful prepyloric lesions. Reflex spasm will be absent, or very much less, after this period of time. In benign prepyloric ulcer, the associated spasm will be less and the ulcer crater, if seen at the original examination, will be smaller. Malignant ulcer, on the other hand, will show very little change in the essential lesion, *i.e.*, the crater, though the amount of associated edema may be decreased.

I do not mean to infer from the above statement that disappearance of crater or shrinking in size necessarily rules out carcinoma, as we have observed carcinomatous ulcers to decrease in size and occasionally even to disappear under continued medical treatment. These cases will require frequent recheck examinations, the interval between which may be increased if the patient remains well clinically, and presents a normal radiographic appearance of the stomach.

DISCUSSION

A comparison of Tables I and III reveals the fact that, in these series of cases, an equal percentage of gastric ulcers and of gastric cancers involved only the small prepyloric segment of the stomach, namely, 10 per cent in each case. In actual numbers of cases, benign ulcer was slightly more common than carcinoma. In consideration of ulcerative lesions in the prepyloric region, if one accepts as proof of the innocence of an ulcer only microscopic examination of the resected specimen, then the incidence of benign to malignant prepyloric ulcer in this series is seven benign to four malignant—almost two to one. If one accepts, as I believe one may, clinical and radiologic evidence confirmed by repeated examinations of the patient, then the ratio in our series is fifteen benign to four malignant ulcers, or almost four to one. From this it will be seen that in any given case showing radiologically an ulcer within one inch of the pyloric sphincter, the mathematical probabilities are at least two to one and more likely four to one that it is a benign ulcer.

The differential diagnostic features of benign ulcer and ulcerating carcinoma are usually distinctive, and either at the first examination, or by repeat examination in two to three weeks' time it is usually possible radiologically to differentiate the two. One must not be misled by the fact that an ulcer is apparently smaller after two to three weeks of medical treatment; ulcerating cancers have been observed to do this. The case must be followed until the ulcer disappears, and repeat examinations must be done after this to be certain that it remains healed.

CONCLUSIONS

(1) Seven cases of benign prepyloric ulcer within one inch of the pyloric sphincter are presented. The proof in each case rests upon serial microscopic sections of all portions of the ulcer.

(2) In a series of 145 consecutive gastric ulcers, benign ulcer in the terminal inch of the stomach, exclusive of the pyloric sphincter, was found to be twice as common as malignant ulcer.

(3) The differential radiologic findings in benign and malignant prepyloric ulcers are discussed, and the value of re-examination in prepyloric lesions is emphasized.

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DISCUSSION

DR. FRED JENNER HODGES (Ann Arbor, Mich.): I have read Dr. Singleton's paper with a great deal of interest, particularly because he is dealing with a problem which has been ardently argued before this and other Societies for years and because his paper shows a real desire to get at the bottom of the question of malignancy in gastric ulcer and to go back to source material for reliable information.

Only by following to the surgical amphitheater those of his patients subsequently operated upon and by visiting the pathologic laboratory to examine removed tissues can the roentgenologist learn to intelligently interpret his fluoroscopic observations.

Dr. Singleton's paper reminds one that it is well to remember that the signs of benignity in an ulcer are largely of the negative variety—that one must be highly suspicious of malignancy. Although he has quoted figures from a relatively small group of cases to show that one may expect ulcers in the immediate prepyloric portion of the stomach to be benign rather than malignant, I believe that it is still a pretty good procedure to suspect malignancy in any gastric lesion. I have a low order of respect for my own ability to establish accurately the benignity of any gastric ulcer upon roentgen evidence alone.

All of these papers emphasize the fact that roentgenologic examination of the gastro-intestinal tract is hard work regardless of the specific methods employed; that any short-cut devised to avoid hard work is fraught with the danger of inaccurate diagnosis.

DR. LESTER LEVYN (Buffalo, N. Y.): Dr. Singleton has presented a most timely paper, because it again brings before us the subject that, though perennially discussed, will always maintain our intense interest. As he has stated, pathologists hold widely different opinions concerning the question of malignant degeneration of benign ulcers. One pathologist may be certain that simple hyperplastic cells are seen in a section of an ulcer, whereas another, in studying the same section, may be equally certain that the cells are of the malignant hyperplastic type.

In a text-book just off the press on "The Stomach and Duodenum," by Eusterman and Balfour and members of the Staff of the Mayo Clinic, McCarty states that in a study of 2,398 gastric cancers, 1,620 subacute and chronic ulcers, he has observed "the various stages of evolution of gastric cancer, and those stages have been most frequent in chronic gastric ulcer." He further states that at least 10 to 15 per cent of ulcers contain cells which cannot be differentiated from cancer cells.

Hampton and Singleton are the only two writers, to my knowledge, who have concerned themselves with prepyloric lesions involving only the terminal one inch of the stomach. I feel that such a distinction is mainly of academic interest; at least until such a time as we have conclusive evidence as to why the immediate prepyloric region is with relative infrequency the seat of benign ulcers.

In most cases it is possible to distinguish roentgenologically between benign and malignant ulcers, but there are instances in which an ulcer presents every characteristic of being benign and yet the patient succumbs to cancer in a short time.

Dr. Singleton emphasized one very important fact, namely, that carcinoma and ulcers may show improvement roentgenologically and in time disappear entirely under treatment. I wish briefly to present such a case.

The patient, a man 48 years of age, was first seen on Nov. 14, 1934, and upon him a diagnosis of peptic ulcer was made from the history, laboratory findings, etc. Roentgen examination showed what appeared to be a benign ulcer on the lesser curvature.

Re-examination on Dec. 1, 1934, after medical treatment and rest in bed, revealed the ulcer to be diminished in size.

Further x-ray study on Feb. 27, 1935, showed complete disappearance of the crater.

On March 8, 1935, the gastro-enterologist reported that the patient was symptom-free, and that he had gained eight pounds. He was instructed to return in three months unless symptoms recurred sooner.

On June 22, 1935, he was still symptom-free. Physical examination, however, disclosed numerous small palpable masses through the abdomen.

Operation on June 28, 1935, found the peritoneum filled with metastases. The liver was free. The primary lesion was located on the lesser curvature, about the size of a half-dollar. It had not perforated.

The chief concern of the roentgenologist is to establish a diagnosis as early as possible, and if there remains the slightest doubt as to whether an ulcer is benign or malignant, the patient should receive the benefit of the doubt by extirpation of the ulcer.

If I recall correctly, several years ago Dr. Cole reported a case in which there was a lesion on the lesser curvature. He was uncertain as to the question of malignancy roentgenologically, but was biased toward malignancy by other factors, such as the age of the patient, the site of the lesion, etc. Operation was performed, and the pathologist reported the specimen as revealing as early a stomach cancer as he had ever seen.

In 1929 Haudek wrote: "We may fairly hope, we may reasonably expect, that it will fall to our lot to attain in the near future yet greater success in the diagnosis of the smallest tumors and of malignant changes in the mucosa over and above the results hitherto reached—results which are even now by no means to be despised.

"One thing is certain—that none but men with a sound knowledge of pathology, clinical medicine, and radiology can ever help cancer sufferers to the earliest possible diagnosis and cure of their disease."

DR. LEWIS GREGORY COLE (New York City): As for Dr. Singleton's paper, I am heartily in accord with practically every statement he made, but before I go any farther I wish to pause to express my affection and respect for one who was a member of this Society and who was associated with me during the War and for a period of time thereafter, and who subsequent to that was professor of roentgenology at Toronto University. I refer to Dr. Dixon, who was Dr. Singleton's predecessor, and I can see by every expression and by his rational reasoning that he was trained by Dr. Dixon. Considering my great respect for Dr. Dixon this quality in Dr. Singleton gives me a great thrill. Dr. Singleton's courage in assembling this material and presenting it at this meeting in opposition to one of high authority who has stated that all these lesions at the pyloric end should be considered malignant until they are proven otherwise, is a trait which he has absorbed from his predecessor. When this statement concerning the malignancy of pyloric lesions was originally made at New Orleans, I felt that it was a most unfortunate one. Perhaps it was intended that this would be a "short cut" for the differentiation of malignancy and non-malignancy in this region; but one sometimes get lost in making short-cuts. Therefore, it is with great pleasure that I congratulate Dr. Singleton on his excellent presentation of this paper.

There is only one statement of Dr. Singleton's to which I would take any exception and that is his statement that "clinical history indicated that they had existed for a long period of time," and yet the pathologic report indicated that these ulcers were in a state of active repair at

the time they were removed by surgical procedure.

About two years ago I had a long talk with Dr. Robinson concerning the repair of gastric ulcers, and his report concerning the rapid repair that was going on in these ulcers at the time it was interrupted by surgical procedure, gives evidence that this conversation is bearing fruit.

Again I reiterate that if the roentgenologic-therapeutic test is made in cases of gastric ulcer, namely, with the patient put absolutely in bed, on a modified diet, with an x-ray examination made every six days—if at the end of seventeen days the ulcer has diminished to one-half the cubic capacity it was shown to have in the first roentgen examination, then it is in a highly active state of repair which should not be interrupted by surgical removal. Ulcers in the pyloric canal involving the fan-shaped muscle may require twenty-four days to reach this stage of repair, namely, the stage of being one-half repaired.

Dr. George W. Holmes (Boston): I want particularly to discuss the paper by Dr. Singleton, because he has repeated a piece of work which we did at the Massachusetts General Hospital some years ago and which appears to have resulted in our becoming recognized as "famous roentgenologists," at least in New York City.

Dr. Singleton's conclusions differ somewhat from ours, but not so much as would appear at first glance. He has done just the sort of thing that I wish could be done more often. When a piece of work is produced, particularly if it is based on statistical data, someone else should repeat it before it is generally accepted. Dr. Singleton has done just that, using practically the same number of cases and studying them in practically the same way, and he has arrived at somewhat different results. I think I could take his material and arrive at somewhat different results, and I have no doubt he could take ours and do the same thing. We all know that statistical data may be misleading.

However, the importance of this problem, if it is of any importance at all, is not wholly dependent upon statistics; there is a human side to it as well. There is a group of cases which all of you recognize, I think, with gastric lesions, the benignancy or malignancy of which we are unable to determine even after careful study, using all methods of examination. It was with this group in mind that we undertook our work.

We wanted to know if there were other means by which we could form a reasonable guess as to whether or not a lesion was benign after we had used all of the usual methods of examination including fluoroscopy and serial films.

With lesions in other parts of the body, we recognize location as of some importance in diagnosis. For instance, a lesion in the apex of the lung may be considered tuberculosis until proven otherwise. We also know that a lesion on the greater curvature of the stomach is in all probability malignant. We think that possibly the location of a lesion, high or low on the lesser curvature, may have some bearing on whether or not it is benign.

If we review the writings of pathologists, roentgenologists, and surgeons, we find that there is a general agreement that as one approaches the pylorus, the malignancy of the ulcerations increase; also, that ulcers in this region are difficult to treat. Gastro-enterologists recognize that an ulcerating lesion close to the pylorus is not only more difficult to treat, but more likely to become malignant.

One of the things that Dr. Cole has objected to is that we recommend operation in these cases, and at New Orleans, where I presented a paper on this subject, he stated that if the roentgenologist even brought up the question of malignancy, and a surgeon was consulted, it meant an operation, and that if the surgeon operated, the mortality was something like 50 per cent; so that as soon as you thought of cancer sufficiently to call a surgeon in consultation, you jeopardized your patient's chances of life by at least 50 per cent.

Now I do not feel that way about surgery. I do not know that we have any better surgeons in Boston than we have in New York, but in Boston they do not operate on patients unless they think it is wise to do so, and when they do operate on this kind of lesion, the patients do not die. We have not had a death as the result of the operation in this group of cases.

Given a patient with a prepyloric lesion, the chances, based on statistical data obtained throughout the country, including Dr. Singleton's data, are at least more than even that it is malignant, regardless of what it looks like. Any chronic lesion that can be demonstrated by x-ray examination in the prepyloric region of the stomach has a greater chance of being malignant than of being benign. Also the chances are that if it is small and doubtful, that it is operable, and if the patient is operated upon, the chances are that he will get well in more than 50 per cent of the cases. If I had a lesion in this part of my stomach, I should certainly have it taken out. I should take no chances of its becoming malignant.

Why did we select this particular region of the stomach and limit its borders so closely?

You who have studied the stomach either with serial films or by fluoroscopic means know that there is a region of the stomach which contracts down to a narrow pencil-like tube as the peristaltic wave passes over the stomach. This is the prepyloric region as we have defined it. The canal does not form with every peristaltic wave, but when the stomach empties, it extends for about two centimeters upward from the pyloric sphincter. In some animals the mucosa in this part of the stomach has a different character. In the rat, for instance, this part of the stomach is of a different color, and anatomists and histologists recognize a difference in its anatomic and histologic appearance. It is quite possible that there is an anatomic reason for the more frequent occurrence of cancer in this area.

I should like to report briefly a case and then I am through.

A patient was brought to me for examination at the Massachusetts General Hospital. She had a prepyloric lesion, much like the first case that Dr. Singleton showed. I reported a prepyloric ulceration, and stated that it was probably malignant.

Operation was advised; there was a delay of ten days or two weeks before it took place. The surgeon who operated was a recognized gastric surgeon. At operation, he could find no definite lesion. He did not open the stomach; he did not feel he was justified in doing so as there was no lesion that he could feel.

I was not present at the operation and we had not discussed the case with the surgeon beforehand. If we had, perhaps he would not have done what he did, but he closed the patient's abdomen and nothing was done. The medical man had told the patient's husband that she had an ulcerating lesion of the prepyloric end of the stomach which was malignant and should be removed. The family decided they did not want to take any chances with such a lesion and agreed to have it out.

The patient was again operated upon and the pyloric end of the stomach removed. The ulceration had healed, leaving a smooth scar with a small crater in the center. The specimen was examined by several pathologists and all but one said it was malignant. The patient recovered from both operations. She is well to-day and free from cancer.

The apparent healing of a gastric ulceration does not prove that the ulceration is benign. The only positive evidence is that obtained from a careful microscopic examination of diseased tissue by a competent pathologist.

ARTHUR C. SINGLETON (closing): It has been frequently said that the discussion is the best part of any paper and I am very pleased with the free discussion which has been accorded the presentation of this paper.

Dr. Hodges has asked why we limit the prepyloric area so definitely to the terminal one inch of stomach. The reason was that

I wished, as nearly as possible, to duplicate the criteria used by Dr. Holmes and his associates in their study of these conditions.

I admit very frankly that the series of cases herein presented is small and represents merely the beginning of our investigation of this subject. I hope that sufficient interest may be stimulated in the subject so that other observers will analyze and present their cases, to the end that accurate statistics may be obtained with regard to the highly controversial subject of incidence of malignancy in prepyloric ulceration.

PRIMARY MALIGNANT TUMORS OF THE SMALL INTESTINES[1]

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IN THE literature, the roentgen-ray consideration of primary malignant tumors of the small intestine is characterized chiefly by its rarity. Most of the contributions consist of case reports or a description of one type of tumor. This may be due to the rarity of these tumors in comparison with malignant tumors occurring in other parts of the gastro-intestinal tract, and also to the fact that in the diagnosis of these tumors the roentgen ray is much less reliable. This is in marked contrast to areas such as the stomach and colon, where malignancy is a common lesion and where the roentgen ray is so exact as a diagnostic agent that malignancy can be detected in its earliest stages.

Small bowel malignancy comprises from 3 to 6 per cent of all gastro-intestinal malignancy, according to reports of various authors. In a report of 38 cases of malignant tumors of the small intestine, Raiford (13) found that they comprised 4.9 per cent of his entire series of gastro-intestinal malignancy.

In this report a general discussion of the subject will be given with reference to the clinical findings, the roentgen-ray characteristics, and the gross pathologic changes. This series is composed of nine cases of carcinoma of the duodenum, three cases of carcinoma of the jejunum, one case of sarcoma of the duodenum and jejunum, and two cases of carcinoid tumors located in the jejunum and ileum, respectively. A few case reports will be given to illustrate the various types of lesions.

MALIGNANT TUMORS OF THE DUODENUM

Primary malignant tumors of the duodenum are a relatively rare occurrence, but not so rare as was formerly believed. They constitute about 3 per cent of all gastro-intestinal malignancies. In a series of 34 malignant tumors of the small bowel, reported by Raiford (11), there were eight primary in the duodenum. In our series of 15 primary malignant small bowel tumors, there are nine primary duodenal tumors. These tumors are almost uniformly adenocarcinomas, but in one of our cases there was a mixed squamous cell and adenocarcinoma originating in the ampulla of Vater.

Mateer and Hartman (8) have classified these tumors on an anatomic basis, with respect to their origin, as follows:

(1) Supra-ampullary carcinoma, arising from the duodenal mucosa between the pylorus and the ampulla of Vater.

(2) Peri-ampullary carcinoma, arising from either (*a*) the papilla of Vater, or (*b*) the ampulla of Vater.

(3) Infra-ampullary carcinoma, originating from the duodenal mucosa between the ampulla of Vater and the duodenojejunal junction.

The clinical findings in these three duodenal areas vary sufficiently to materially aid in the anatomic localization of the lesion, although the x-ray findings give a more exact localization. Eusterman, Berkman, and Swan (2) state that approximately 66 per cent of carcinomas of the duodenum occur in the second or ampullary position; 22 per cent in the first or supra-ampullary portion, and 12 per cent in the third or infra-ampullary portion.

The clinical picture depends upon the location of the growth and the degree of obstruction present. Tumors involving the supra-ampullary portion may produce symptoms simulating obstruction of the pylorus. Those involving the peri-ampullary portion may produce obstruction of the ampulla with jaundice. Jaundice as-

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sociated with this lesion may be intermittent or continuous; it may develop early or late, depending upon the exact location and extent of the newgrowth. Obstruction here may also produce secondary changes in the bile ducts and liver which tend to cloud the picture. In the infra-ampullary tumors, jaundice is not present. Vomiting may be profuse and may contain bile and pancreatic juice.

Pain is the first prominent symptom. It is commonly present in the epigastrium, although it has no relation to meals, and may be relieved by alkali. In some instances it may be paroxysmal, but usually is less pronounced and more constant. Nausea and anorexia are common but occur later than pain. Vomiting is usually present and may afford temporary relief of symptoms. There is usually loss of weight and there may be cachexia.

A tumor may be palpated in from 30 to 50 per cent of the cases, depending upon the stage of the disease. The liver may be enlarged. There is often tenderness to palpation over the tumor area.

The stool examination almost always reveals evidence of occult blood: blood is frequently present in the vomitus or stomach contents. Mateer and Hartman (8) stress the diagnostic value of duodenobiliary drainage in patients with jaundice. They state that three negative attempts to secure bile in the course of a week or ten days strongly suggests that the jaundice is due to malignant obstruction of the lower biliary tract.

Positive roentgen-ray findings depend upon the stage of the disease, and the amount of deformity or obstruction of the duodenum which is present at the time of the examination. Dilatation of the duodenum is a common finding and is a sign of obstruction of varying degree, which may be due to a constricting malignancy or to a polypoid tumor filling the lumen. There are usually vigorous reverse peristaltic waves in the duodenum proximal to the point of obstruction. Six-hour gastric retention is present in cases in which there is sufficient duodenal obstruction.

The filling defect may be of several types, the most common being an irregular narrowing produced by encroachment upon the duodenal lumen. This shows a narrow canalization suggesting an encircling lesion. In other cases there may be an abrupt blockage of the duodenal lumen by a tumor filling the lumen. Occasionally, a defect may be localized in one wall of the bowel, suggesting an ulcerative lesion.

The x-ray is not as exact a method of diagnosis in this area as it is in other parts of the gastro-intestinal tract, in which areas its high reputation as a diagnostic agent is richly deserved. Raiford (11) reports that in 14 cases of recognized small bowel tumors the roentgenogram was responsible for the diagnosis in eight. Eusterman, Berkman, and Swan (2) report that the roentgenograms were negative or inconclusive in three of the ten cases submitted to this test. In a number of the other cases the findings consisted of a dilated stomach with moderate to high grade retention. In our series of nine cases of duodenal malignancy, there were suggestive roentgen-ray changes in one case, and in five there were definite localizing findings. In two cases there were negative findings, and in one case the examination was omitted because of the patient's condition.

Primary sarcoma of the duodenum may occur but it is a rare disease. Prey, Foster, and Dennis (10) were able to find but 61 cases recorded in the literature, to which they added one case. In this group of cases, lymphosarcoma occurred 35 times, spindle-cell sarcoma five times, myosarcoma four times, melanosarcoma three times, and myxosarcoma once. In these 48 cases only was the histologic picture described in such a way that the proper classification of sarcoma could be made. Sarcomas may grow to an enormous size with an average reported weight of 500 grams. In many cases the bowel is infiltrated in such a way that it becomes a rigid tube but with very little encroachment upon the lumen. It is for this reason that these tumors reach such an enormous size before causing obstructive symptoms.

We have found no primary sarcoma of the duodenum in our group of cases.

Raiford (13) states that carcinoma occurs more frequently in the duodenum than in any other portion of the small bowel. There is considerable disagreement in the literature concerning this, but in our series of 15 cases of small bowel malignancy there are nine cases of duodenal carcinoma. This would seem to support the contention that duodenal carcinoma is relatively the most common lesion.

Metastases from carcinoma of the duodenum occur with great frequency and are usually found in the regional lymph nodes, liver, pancreas, and occasionally in the lungs. In our nine cases, metastases were demonstrated in seven cases. The gross pathology of these tumors consists of the following: (1) the ulcerative type; (2) the polypoid type; (3) the infiltrative type.

The ulcerative type frequently consists of a large ulcer with heavy rolled indurated edges. The polypoid type may be exceedingly small, or may be so large as to entirely occlude the lumen of the duodenum. They are the type that most frequently cause obstructive phenomena. The infiltrative type is often hard and fibrous in appearance, and may have a ragged ulcerated appearance.

CASE REPORTS

Case 1. W. T. A., Case No. 170,623, a white male, aged 64 years.

Complaint.—Epigastric pain radiating up between the shoulder blades.

Present Illness.—This attack began two months previously, with epigastric pain, nausea, belching, bloating, and anorexia. Pain was relieved by food. Loss of weight was eight pounds in three weeks. He had had three similar attacks during the preceding 18 months. The pain originated in the mid-epigastrium, being relieved at times by soda or food. It had no relation to meals, but sometimes awakened the patient at night and was followed by residual soreness.

Physical Examination.—The patient was a well developed white male, with a moderate amount of icterus in the scleræ. The chest was normal. The liver margin was two inches below the costal margin, and was tender to palpation. No abdominal mass was found.

Laboratory Examination.—The stools were all positive for occult blood. Bile was found in the first stool specimen, but subsequent specimens were negative for bile. There was a mild secondary anemia.

Roentgen-ray Examination.—Gall-bladder films were negative for calculi. The stomach was negative. The second portion of the duodenum was definitely narrowed and constricted with an irregular lumen (Fig. 1). There was no obstruction to the passage of barium through the duodenum.

Operative Findings.—There was a hard mass in the second portion of the duodenum suggesting malignancy, with multiple metastatic nodules in the liver. The common duct was obstructed. Several large gallstones were found in the gall bladder. No attempt at surgical removal was made. The patient died nine days later of massive hemorrhage from the bowel.

Postmortem Findings.—Adenocarcinoma of the supra-ampullary portion of the duodenum with metastases to the liver, pancreas, and regional lymph nodes. Chronic cholecystitis and cholelithiasis. Hemorrhage from an eroded vessel in the base of a malignant ulcer.

Case 2. F. L. M., Case No. 186,017, a white male, aged 53 years.

Complaint.—Epigastric pain and jaundice.

Present Illness.—This began two months previously, with severe attacks of pain in the upper abdomen. These attacks lasted for about five minutes. One month later he developed nausea, anorexia, occasional vomiting, and increased pain. Definite jaundice was present at that time. There has been a weight loss of 35 pounds in two months. The stools have been clay colored for three weeks. There was no history of hematemesis.

Physical Examination.—He was a poorly nourished white male, with definite jaun-

Fig. 1.

Fig. 2.

Fig. 1. Case 2. Supra-ampullary carcinoma of the duodenum, showing an irregular narrowing, with partial obstruction.

Fig. 2. Case 2. Peri-ampullary carcinoma of the duodenum, showing a narrowing of the duodenum, with no obstruction.

dice. The chest was negative; no masses were felt in the abdomen. The liver edge was not felt but there was definite tenderness over the gall-bladder area.

Laboratory Examination.—Three stool examinations showed evidence of occult blood and one other was negative. No bile was found in the stools. The Wassermann was negative. There was a mild secondary anemia.

Roentgen-ray Examination.—The stomach was negative. The lumen of the second portion of the duodenum was irregular and displaced somewhat laterally, and there was a pressure defect in the cap (Fig. 2). The duodenum emptied slowly and no peristaltic waves were seen. There was 15 per cent retention in the stomach in six hours.

Operative Findings.—Cholecystitis with cholelithiasis. Marked dilatation of the common duct. Induration of the head of the pancreas; a section showed no malignancy of this area. The patient died one week later, with evidence of massive hemorrhage into the bowel.

Postmortem Findings.—Adenocarcinoma of the duodenum at the papilla, with obstruction of the common bile duct. Intestinal hemorrhage without gross evidence of bleeding point. Hemorrhagic pancreatitis. No metastases were found.

Case 3. H. S., Case No. 166,264, a white male, aged 71 years, admitted Aug. 12, 1931.

Complaint.—Upper abdominal pain, anorexia, and loss of weight.

Present Illness.—Three months previous to admission, he had a cholecystectomy performed in another city. This followed an attack of severe pain in the right upper quadrant. He received no relief from this operation, still having severe right upper quadrant pain and recently has had to take narcotics to control it. There was a weight loss of 55 pounds during the previous four months. He has had increasing anorexia and epigastric distress. Since his operation he has had tarry stools at intervals, but recently they have become clay-colored.

Physical Examination.—A poorly nourished white male who appeared acutely ill. The scleræ showed slight icterus. The chest was negative. There was a hard

Fig. 3.

Fig. 4.

Fig. 3. Case 3. Infra-ampullary carcinoma of the duodenum, showing filling defect in third portion of the duodenum, with partial obstruction.
Fig. 4. Case 4. Carcinoma of the jejunum, showing an obstruction in the upper jejunum.

mass the size of a small orange in the epigastrium. It was movable, descended with inspiration, and could be pushed across the mid-line to the left side. There was tenderness present to deep palpation. The liver edge was not felt.

Laboratory Examination.—The Wassermann was negative. The hemoglobin was 34 per cent. Red blood cells, 2,740,000; white blood cells, 6,600. Four stool examinations showed occult blood. Gastric analysis revealed gross blood, bile, and food residue. There was absence of hydrochloric acid in the stomach contents.

Roentgen-ray Examination.—The stomach was negative. There was a definite stasis of barium in the duodenum, with an obstructive lesion in the third portion. At this point there was an irregular filling defect (Fig. 3). There was slight six-hour retention in the stomach. These findings suggested a tumor obstructing the infra-ampullary portion of the duodenum.

Operative Findings.—There was a large mass in the region of the duodenum and gall bladder, which was not removed as there were multiple metastatic nodules in the liver and spleen. One of these nodules was removed and was found to be metastatic carcinoma. Twelve days later the patient expired from massive internal hemorrhage.

Postmortem Examination.—A large crater-like ulcer was found 13 cm. below the pyloric ring and 4 cm. below the papilla of Vater. It was 6 cm. in diameter and 1 cm. in depth; a large artery opens into this crater-like ulcer. The anatomic diagnosis was primary carcinoma of the duodenum in the infra-ampullary region, with extension to the head of the pancreas, and metastases to the regional lymph nodes, liver, spleen, and lungs.

PRIMARY MALIGNANT TUMORS OF THE JEJUNUM AND ILEUM

Duodenal tumors present clinical symptoms of such a nature that one can rather accurately localize that portion of the duodenum from which they arise. Unfortu-

nately, such is not true of tumors in the jejunum and the ileum. Hence, tumors of these two segments will be considered together. The relative incidence of carcinoma in the last two segments is interesting. The jejunum, the middle segment of the small bowel, occupies a mid-position as a seat of carcinomatous growths; it has less than the duodenum and more than the ileum. The ileum, the last and longest segment, contains the fewest tumors, and according to Joyce (4) these are found largely in the terminal ileum.

Malignancies of the jejunum and the ileum fall largely into two pathologic categories—carcinoma and sarcoma. The clinical, roentgenologic and pathologic findings in each group will be considered. Some case reports illustrating the two types of tumors will be included.

Malignancies of these portions of the small bowel fall into two principal clinical groups. In the first and larger group, the arresting symptoms are regional, associated with constitutional changes. In the second and smaller group, the outstanding symptoms are constitutional, associated with obscure or late regional manifestations. These will be discussed in the order mentioned.

In Group I the regional or abdominal symptoms are brought about by obstruction of the bowel. Intestinal obstruction may be produced by (1) intussusception, or by (2) occlusion of the lumen by a tumor. As the symptomatology varies somewhat in the two conditions, each will be discussed separately.

(1) Intussusception.—Speese (14), reporting Kasemeyer's investigations of intussusception, states that 30 per cent of these cases were caused by malignant formations. Raiford (13) found it in 23 per cent in his series. The onset is sudden. The pain, which is acute, and may not abate for several hours, is usually located in one of the lower quadrants. It may cease suddenly if spontaneous reduction occurs, but may become chronic with periods of remission. Intussusceptions produced by neoplasms differ somewhat from intussusception in children. The mechanism of production is different, and those produced by tumors do not tend to undergo spontaneous reduction. In children, intussusception is produced by a hyperactive gut. In malignancy, the condition is developed because intestinal peristalsis endeavors to sweep the tumor along as it would bowel contents.

Vomiting usually begins shortly after the onset of pain. It rarely progresses to the stage of fecal vomiting. The vomitus is thick and bile-stained and may show evidence of pancreatic digestion.

The bowels may move once normally after the onset. When the condition is fully developed, however, obstipation is complete. Blood or mucus may be passed fairly early: the former is very suggestive of the diagnosis.

A mass can usually be palpated. It is usually sausage-shaped, and is located in the region of the umbilicus. Its appearance will be somewhat modified by the traction of the mesentery on the attached border of the bowel. The mass will be very firm during a contraction of the bowel, and may increase in size as the condition progresses.

The abdomen is somewhat distended but not very tympanitic. Visible, audible, or palpable peristalsis may be observed.

The patient has an anxious appearance, and is pale. The skin is clammy and covered with cold perspiration. The pulse is rapid, thready, and of poor volume. The respirations are rapid and shallow. He is listless, and the temperature is normal or subnormal.

The above signs are present in a representative case in obstruction produced by intussusception.

(2) Occlusion by Tumor.—Intestinal obstruction, produced by gradual occlusion of the lumen of the bowel by a neoplasm, is somewhat different from intussusception. Obstruction is usually preceded by a group of mild prodromal symptoms. For some time the patient may complain of belching, bloating, or a feeling of heaviness in the abdomen. There may be a "below par" feeling, fatigability, and weight loss.

As the lumen of the bowel becomes more encroached upon, the patient will present the findings of intermittent intestinal obstruction. There is a sharp, colicky intermittent pain in the median line above or below the umbilicus. It may radiate to the epigastrium. The waves of pain are shorter in duration than in colonic obstruction.

Nausea and vomiting usually occur; vomiting is rather profuse if the lesion is high in the jejunum. Some distention may be seen. Constipation is the rule; it may alternate with diarrhea during which blood and mucus may appear in the stool.

With treatment or perhaps without treatment the patient may become symptom-free and remain so for weeks. He may have intermittent exacerbations and recurrences over a period of a year or more.

Eventually acute intestinal obstruction develops. Sudden acute, cramp-like pains occur in the region of the mid-abdomen; they may be above or below the umbilicus, and may be continuous. Vomiting soon follows, and has the sequence of gastric, biliary, and fecal vomiting. Vomiting is continuous and obstipation is complete.

The physical findings in acute intestinal obstruction are as follows:

Inspection: facies are anxious, eyes are sunken. The patient has a dusky appearance.

Peristaltic waves may be seen. The abdomen is at first slightly distended, but later distention increases and becomes quite pronounced. Distended coils can often be seen in the lower abdomen. In very thin persons, however, both distention and peristalsis must be seen together to justify a diagnosis of intestinal obstruction. Peristalsis without obstruction may be observed in very thin persons.

Palpation of the abdomen reveals no rigidity. Tenderness is not present unless distention is pronounced. A mass may be palpated if distention is not too great; according to Lynch (7), if located in the lower ileum, a small, firm, movable lump may be palpated. These masses have a tendency to drop down in the pelvis and may be palpated *per rectum*. If the mass slips away from the fingers, it is almost sure to be in the jejunum or ileum if in the gastro-intestinal tract at all. Joyce (4) considers a palpable mass probably the most important physical sign to be looked for. Johnson (5) states that if the lesion is in the upper jejunum, only one coil of distended bowel may be found.

On auscultation, gurgling, and rumbling noises associated with active peristalsis can be heard, unless meteorism is so pronounced that intestinal paresis has occurred.

The temperature is normal or subnormal, and the urine is scanty. There is an increase in the leukocyte count. The patient may be anemic, emaciated, and cachectic. Stool examination is usually positive for occult blood. The evaluation of the latter finding varies with different writers.

II. In the second or smaller group of carcinomas of the two distal segments of the small bowel, the arresting symptoms are constitutional. Here the malignant mass is extra-lumenal in development. The patient complains of weakness, fatigability, shortness of breath, and loss of weight. Only a few cases are in this second group.

The roentgen-ray examination is of very little value in the diagnosis of carcinomas of this group. Obstruction does not occur, so that delay in the passage of the barium meal through the bowel is not seen.

Roentgen-ray Examination.—A plain film of the abdomen may reveal a dilated small bowel, the identity of which is established by the "herring-bone" effect. Occasionally, soft tissue tumor outline can be made out which, of course, cannot be differentiated from any other abdominal mass. Delayed emptying may be seen when the intestinal lumen is only partially occluded. Dilated loops of small bowel or unusual intestinal patterns may be noted. Obstruction, partial or complete, may be seen and the exact point determined. In complete obstruction, the distal end of the barium column has a round or bulbous contour. The bowel above is much dilated. In incomplete obstruction, much the same pic-

ture is presented except that some barium can be seen to trickle by the obstruction. In all of our cases of carcinoma of the jejunum there was almost complete obstruction, with marked dilatation of the bowel above.

Filling defects may be seen, particularly in the terminal ileum. These are very valuable, if constant. The possibility of an extra-intestinal mass producing the filling defect must be kept in mind.

Carcinomas of the jejunum and the ileum fall largely into the following three groups: (1) Those developing from local or general intestinal polyposis (rare); (2) those arising in carcinoid tumors; (3) those originating in various conditions, the most common of which is a single intestinal polyp. This type is the most common, and tends to ulcerate, undergo scirrhous change, and produce obstruction. We have had three cases of carcinoma of the jejunum, all of which produced constriction of the lumen of the bowel and exhibited symptoms of obstruction.

Obstructive Signs.—Colicky pains, vomiting, and complete obstipation; these and positive x-ray findings make the diagnosis of intestinal obstruction certain. If a palpable mass is found and the patient is in the fifth or sixth decade of life, carcinoma must be considered.

Case 4. C. S., female, Case No. 210,041.

Chief Complaint.—"Sick spells"; loss of appetite, weight, and strength; constipation.

Past History.—The patient was well up until about eight months prior to her admission to the hospital, with the exception of an occasional headache and backache, a condition which had existed during the past two years.

Present Illness.—In September, 1934, the patient began to notice loss of strength and appetite, which has been progressive. She has had bloating, belching, nausea, and vomiting since September, 1934. The vomiting, which usually occurred about one hour after meals, gave relief; the vomitus was greenish in color. It was not always preceded by nausea and occurred every second or third night. She noticed a change in the caliber of the stools and thinks that there has been some blood and mucus in them. Constipation is growing worse. Gurgling was noted in the upper abdomen after taking fluids; she has had mild cramps in the abdomen.

Physical Examination.—Only the significant findings will be recorded. Thin, weak, emaciated female, about 60 years of age. Her abdomen is soft; the right side is not tender. To the left of the umbilicus, the contraction of the bowel is felt. Here a nodular, tender mass the size of an egg can be felt.

Laboratory Findings.—Blood, R.B.C. 4,210,000; W.B.C. 11,000; Wassermann negative; urine negative. Guaiac positive; gastric analysis, no free hydrochloric acid.

Roentgen-ray Findings.—The stomach is large, hypomotile, and shows 50 per cent retention at the end of six hours. There is an obstruction in the jejunum about four inches from its upper end. The bowel is markedly dilated above this (Fig. 4). The impression was that the obstruction of the jejunum was probably malignant in origin.

Operative Findings.—The greatly distended first portion of the jejunum was easily brought up into the wound, and with it came the area of obstruction. There was a puckering of the bowel which looked as if a string had been tied around it. A tumor was palpated which was causing the obstruction. Adjacent to the tumor was a large mass in the mesentery and several smaller ones higher up. These were thought to be metastatic in origin.

PATHOLOGIC REPORT

Gross Pathology.—The specimen consists of a piece of jejunum 15 cm. in length, and from 6 to 8 cm. in circumference. In the center of this is a markedly constricted area occupied by a fungating mass 3 × 4 cm. in diameter. This tumor is grayish, friable, and very cellular. A lymph node, which is 2 cm. in diameter, is present in the mesentery adjacent to the tumor. This

Fig. 5.

Fig. 6.

Fig. 5. Case 5. Carcinoma of the upper jejunum, with high grade obstruction.
Fig. 6. Case 6. Aneurysmal-like sac in sarcoma of the small intestine.

proved to be adenocarcinoma of the jejunum.

Case 5. A. L., male, Case No. 205,341.

Chief Complaint.—Cramp-like pain in the abdomen; loss of weight, strength, and appetite.

Present Illness.—Anorexia began three months ago. Nausea and vomiting occurred weekly at first, but later daily. Vomitus is greenish; there has been no blood in vomitus or stools. Weakness is very pronounced. There has been intermittent bloating over a two months' period. Constipation is growing worse.

Physical Examination.—The patient is a white male, aged 51 years, sallow and under-nourished. The abdomen is soft. Palpation produces griping pains. No mass or evidence of tenderness is found. Visible and audible peristalsis are described by the patient.

Laboratory Findings.—R.B.C., 3,710,000; W.B.C., 5,450; Wassermann, urine, and Guaiac tests are negative. Gastric contents show no free HCl.

Roentgen-ray Findings.—Hypermotility of the stomach and dilatation of the jejunum, with partial obstruction (Fig. 5).

Operative Findings.—A tremendously dilated bowel is followed down until a tumor mass is found. This is about three or four feet from the beginning of the jejunum. Two masses involving the bowel are found. These are hard, and appear to cause complete obstruction. Involved mesenteric glands are present.

Pathologic Diagnosis.—Jejunum: multiple scirrhous carcinoma, probably arising in carcinoid tumors.

Autopsy Findings.—Acute purulent peritonitis; perforation of the bowel at sigmoid colon and stump of anastomosis; mesenteric lymph adenopathy; mesentery of small intestine.

SARCOMA OF THE JEJUNUM AND ILEUM

Histologically, sarcoma of the intestine falls into three main groups: spindle-cell sarcoma; miscellaneous sarcoma, and lymphosarcoma. The last of these is the one with which we are principally concerned in this paper.

According to Mumey (9), 65 per cent of the sarcomas of the intestine are found in the small bowel. The ileum is the site of election, but the jejunum may also become involved. The relative rarity of the condition is attested by the statistical comparisons of Graves (3), who states that Nothnagel found only nine cases of lymphosarcoma in 21,358 autopsies, at the Vienna General Hospital. According to Graves (3), Muller found only one case of lymphosarcoma of the intestine in 102 cases of sarcoma which came to autopsy. Boyce and McFetridge (1) estimate that something over 300 cases had been reported up to 1934.

The fourth decade shows the highest incidence of involvement. Males are more frequently affected than females in the ratio of two to one.

In a representative case the first symptom is usually pain, which is generalized and epigastric rather than abdominal in location. According to Ochsner, this pain is not relieved by rest or starvation; it is unrelated to food intake or bowel function. The pain is always colicky in character and is followed by loss of appetite. Nausea and vomiting may occur but are not the rule.

There is a change in the bowel habit. Diarrhea, constipation, or an alternation of these two may appear. Acute obstruction is not the rule unless the growth is of the annular type or intussusception occurs. Distention is seen and borborygmus is common. If a mass is found, it is usually firm and not tender. Fever is often observed, and there is a pronounced loss of weight. The examination of the blood shows a secondary anemia and sometimes a leukocytosis. Blood in the stools is found in a small proportion of the cases and is sometimes one of the earliest symptoms. Edema of the legs is reported by Libman (6).

Roentgen-ray Examination.—The roentgen-ray findings in sarcoma of the small bowel are very similar, in most instances, to the findings in carcinoma of the same area, and, therefore, no detailed description will be given of the usual findings.

Occasionally, however, a large localized dilatation of the small bowel may be seen with only partial obstruction of the bowel. This was noted in a case of reticulum-cell sarcoma in which the localized dilatation was 10 centimeters in diameter. At the four-hour interval there was a decrease in the density and the size of the barium shadow. At the eight-hour examination only the outlines of the sac could be seen. No other condition in the small bowel produces a picture that in any way simulates this. The diagnosis of sarcoma of the small bowel can be made with a high degree of accuracy if such a picture as this is seen.

Gross Pathology.—Lymphosarcoma may be found in both the large and small bowel, but occurs much more frequently in the small. It is usually found in the terminal ileum. Involvement of the duodenum and jejunum has been reported.

The newgrowth originates in the submucosa and usually assumes one of the following three types:

(1) The annular type, which according to most authors is not common.

(2) Polypoid growth, which may or may not ulcerate.

(3) A large subserous adherent tumor, which ulcerates and excavates or produces aneurysmal dilatation. The latter form was seen in our case. One case is reported.

Case 6. E. B., female, Case No. 208,112.

Chief Complaint.—Loss of weight, morphinism.

Past History.—Diagnosed tuberculosis in 1926. Has had pneumonia twice. Treated for syphilis in 1929.

Present Illness.—The patient has been losing weight for two months. She has had periods of diarrhea, lasting for several days at a time. She denies passing any blood during diarrhea attacks. For six months the patient has noted griping abdominal pains after eating solid food. These usually began one to two hours after meals. Some bloating was also noticed with the attacks of pain. The pain started in the epigastrium and extended downward to the left lower quadrant. Some vomit-

ing has occurred, but no blood has been seen. Bowel function has been fairly good.

Physical Examination.—Marked emaciated white female, about forty years of age. Some distention of lower abdomen was noted. Left lower quadrant was quite tender. Tenderness was noted over the entire colon and epigastrium. No masses were felt. Neither visible, palpable, or audible peristalsis was found early, but visible peristalsis was observed later.

Laboratory Findings.—Blood Wassermann was negative; R.B.C., 4,510,000; W.B.C., 4,450; urine negative; stools negative for occult blood.

X-ray Findings.—The stomach showed 50 per cent retention of barium at the end of six hours. The cap was negative. Slow peristalsis was seen in the duodenum. Obstruction in the jejunum, with localized dilatation of the bowel 10 centimeters in diameter (Fig. 6).

Operative Findings.—Two large cyst-like cavities, adjacent but not continuous. Four ulcerated areas in the lower duodenum and upper jejunum.

Pathologic Report.—Gross pathology—two pieces of small bowel, with large cyst in one and inflammatory mass in the other. The inflammatory mass appears to be sacculated. Microscopic pathology—reticulum-cell sarcoma of duodenum and jejunum.

Autopsy.—Lymphosarcoma, reticulum-cell type, involving wall of the stomach and the jejunum.

CARCINOID TUMORS

These tumors originate from the argentaffine cells of the normal intestinal mucosa. Grossly, they appear in the submucosa. They are found in the stomach, small intestine, large intestine, appendix, and occasionally in a Meckel's diverticulum, but most commonly in the appendix. Next in order of frequency is the small bowel; rarely are they found in the stomach and colon. In these areas they are larger and tend to metastasize. We are reporting two cases of carcinoid tumors of the small intestine which were malignant.

In the two cases that we observed, the roentgen-ray findings did not indicate evidence of obstruction, and no filling defects were seen. The bowel pattern was somewhat unusual, but to us was not diagnostic.

SUMMARY

In this discussion of primary malignancy of the small bowel, we have divided the bowel area into two parts, namely, the duodenum, and the jejunum and ileum. The clinical and roentgenologic findings in the duodenal area are somewhat different from those in the bowel lower down. Those in the jejunum and ileum are of sufficient similarity to justify us in classifying them together.

Nine cases of carcinoma of the duodenum are reported. Anatomically, they occur as supra-ampullary, peri-ampullary, and infra-ampullary lesions. They may all produce clinical signs of obstruction of the duodenum, while the peri-ampullary type, in addition, is associated with varying degrees of jaundice, depending upon the degree of obstruction of the ampulla. Pain is the most prominent symptom. Occult blood is almost always found in the stool. The x-ray changes may vary from an irregular narrowing of the lumen to a complete obstruction, with filling defect. These tumors are usually adenocarcinomas. Metastases occur with great frequency to the regional lymph nodes, liver, and pancreas.

Primary sarcoma of the duodenum is very rare; only about 60 cases are reported in the literature. Lymphosarcoma is the predominating type. Such growths attain a large size, with infiltration of the bowel wall, but with very little encroachment upon the lumen.

Malignant tumors of the jejunum and ileum have fewer localizing symptoms and signs than those of the duodenum. Obstructive symptoms and signs are the most common findings in this group of tumors. Obstruction may be caused by intussusception of the bowel or by occlusion of the lumen by the tumor.

Carcinoma of the jejunum and ileum

usually originates in intestinal polyps. They tend to ulcerate, undergo scirrhous change, and produce obstruction. The roentgen examination shows either partial or complete obstruction, with the usual attendant signs. A filling defect may also be present.

Sarcoma of the small intestine is most commonly found in the ileum, although it is found also in the jejunum. The clinical findings do not differentiate it from carcinoma. Occasionally, a localized dilatation without obstruction is seen on the roentgenogram. This rare finding is an aneurysmal-like dilatation, and strongly suggests sarcoma of the small intestine.

Carcinoid or argentaffine-cell tumors may be found throughout the gastro-intestinal tract, but occur most frequently in the appendix, and next most frequently in the small intestine. They are of low grade malignancy, and in some instances are said to be benign. We report two cases of malignant carcinoid tumors of the small intestine.

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THE ROENTGEN DIAGNOSIS OF MALIGNANT TUMORS OF THE STOMACH

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THE purpose of this paper is to present in summary the cardinal facts about the roentgen diagnosis of gastric cancer. The most successful means to date of establishing an early diagnosis of this disease lies in the prompt use of the roentgen rays after an opaque meal. The presence of the classical signs and symptoms of gastric cancer as found in text-books, usually indicates an advanced stage of the disease. It has been only a generation since Cannon (1) reported his famous observations on fluoroscopy of the gastro-intestinal tract of the cat, following ingestion of an opaque meal (May, 1897).

Perfection in detail of this method of visualizing the stomach has been an even more important factor in the improved curability of gastric cancer than has advancement in surgical technic during the same period. In 1900, Osler (2) termed cancer of the stomach "the most hopeless of all diseases," yet now the surgeon has a better opportunity to cure it because of the

Fig. 1. On the greater curvature of the pyloric third of the stomach is observed a niche which proved on biopsy to be an ulcerative carcinoma. Rupture of the lesion produced peritonitis, from which the patient recovered after operation and drainage. Gastro-enterostomy was done after exclusion of the carcinomatous distal third of the stomach. Subsequent radiation therapy afforded palliation for two and a half years.

Fig. 2. Normal roentgenographic appearance of stomach. Autopsy revealed diffuse microscopic carcinoma of gastric mucosa, small cell type, extending from multiple foci into submucosal lymphatics. Diffuse lymphatic pulmonary carcinosis. The x-ray studies revealed a normal gastric contour and no interference with peristalsis.

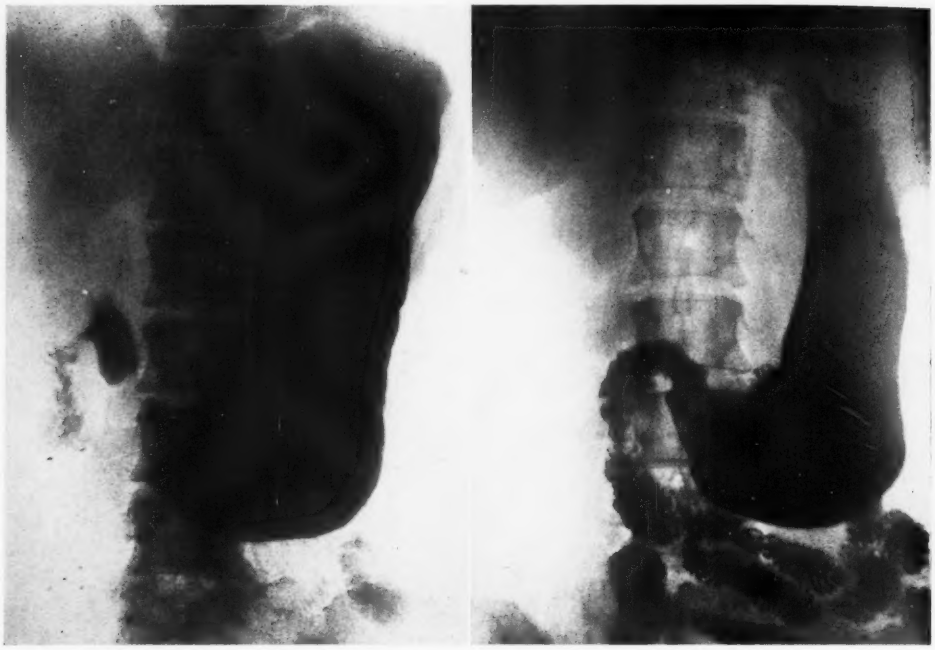

Fig. 3-*A*. Fig. 3-*B*.

Fig. 3-*A*. Roentgenogram made of the stomach in May, 1929, showing the presence of a bulky carcinoma involving the pylorus and antrum.

Fig. 3-*B*. Roentgenogram of the same stomach in April, 1934, seven years after partial gastrectomy and a Billroth I anastomosis. Irregularity of prepyloric region is the result of the operative procedure. This patient is still living and well (December, 1935).

proper and early institution of roentgen diagnosis. A knowledge of the basic facts about the roentgen diagnosis of malignant tumors of the stomach should be an important part of the armamentarium of every surgeon and physician.

TECHNIC

The elicitation of signs of gastric carcinoma requires careful attention to both fluoroscopic and radiographic technic. The patient usually appears for examination in the morning hours, having abstained from breakfast. The cervical region, chest, and abdomen are examined in various positions to observe abnormalities related to the symptoms before the patient is allowed to swallow the opaque meal (in the erect position). Then, with the body turned slightly to the left, the esophagus is carefully examined with not more than one or two swallows of barium sulphate suspension. Special care is taken to observe the distal end of the esophagus in order to determine any delay in the passage through the cardiac orifice or to detect slight irregularities in the contour of the profile. At the same time the cardiac portion of the stomach is studied for possible filling defects or niches. Occasionally, a soft tissue mass may be observed against the outline of the gas bubble shadow in the fundus or dome of the stomach. The patient is turned slowly while under observation, from the left to the original anterior position. The examiner palpates the stomach thoroughly with the gloved hand to determine the integrity of the mucosal pattern. In the normal stomach there is observed alternate light and dark lines, running in fairly parallel fashion, which represent the normal rugæ and inter-rugal furrows. The diseased stomach shows a de-

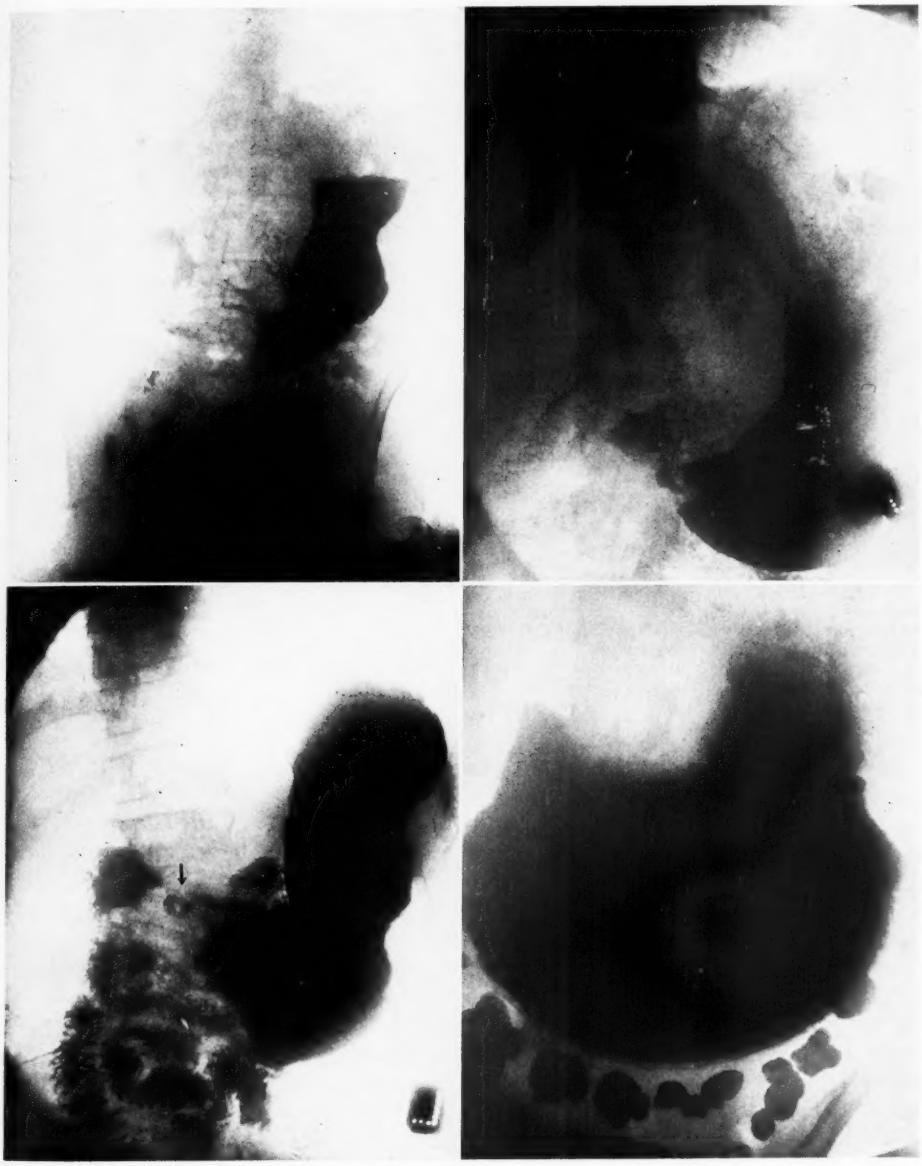

Fig. 4 (*upper left*). Irregular, annular, tapering filling defect produced by a bulky cellular adenocarcinoma in the pyloric antrum.

Fig. 5 (*upper right*). Rather small irregular filling defect due to carcinomatous involvement of prepyloric region. Solid adenocarcinoma, Grade III.

Fig. 6 (*lower left*). Annular defect of pyloric antrum due to pyloric carcinoma. Ring-shaped dense barium fleck filling ulcer crater in the carcinoma. Resection revealed tubular adenocarcinoma. Patient now living and well after four and a half years.

Fig. 7 (*lower right*). Annular, tapering, filling defect of prepyloric region with pyloric stenosis. Stomach is markedly dilated. Almost complete retention at end of six hours. Peristaltic activity absent. Autopsy: diffuse tubular adenocarcinoma.

Fig. 8. Polypoid carcinoma of the stomach producing a large oval filling defect with smooth borders located on the posterior wall near the lesser curvature in the pyloric antrum. Pathologic diagnosis: Fully malignant solid aveolar carcinoma, Grade III, roentgen symptoms of only one week's duration. First sign was hematemesis following a parachute jump.

Fig. 9. Irregular polypoid carcinoma of pyloric antrum producing large defect in lumen, extending from lesser to greater curvature of the stomach. No obstruction. Partial gastric resection revealed bulky solid adenocarcinoma, Grade III.

parture from this picture. This manipulation is done best by the employment of a thin suspension of barium sulphate or a mixture recommended by Rendich (3), (equal parts of the contrast material and mucilage of acacia). Following this part of the examination, the stomach is distended more fully with the contrast medium in order to observe the peristaltic activity in the prone as well as in the erect position. The supine and Trendelenburg positions are used routinely for further observation of the cardia. In some few instances these latter positions will also be of definite value in the diagnosis of lesions of the pars media and pylorica. The position of the stomach is marked on the skin with a small strip of adhesive plaster to guide the technician in the making of the radiograph. At least one film is taken routinely in the prone position for the study of the rugæ. The final examination is made six hours after the ingestion of the meal, for the determination of the presence or absence of gastric retention and to note the position and progress of the contrast material in the intestines.

The principal signs of gastric carcinoma are demonstrated in the accompanying reproductions of films. The filling defect is the cardinal sign of the disease. As early as 1903, Williams (4) stated that, "After the various characteristics belonging to the stomach in health have been established, the presence of abnormal conditions of this organ, such as some cases of malignant disease, will perhaps be more fully recognized than at present. The constant presence of the darkened area in the stomach, for example, may suggest the thickening of its wall due to a malignant disease; some displacements or adhesions may be recognized, as well as hour-glass contractions, or an unusual delay in the digestive process." The niche may or may not be a sign of gastric cancer, depending upon its location; if

Fig. 10. Carcinoma of pars media producing an annular filling defect. "Straight line" deformity of the lesser curvature and irregularity along the greater. Remainder of the stomach outline has normal appearance.

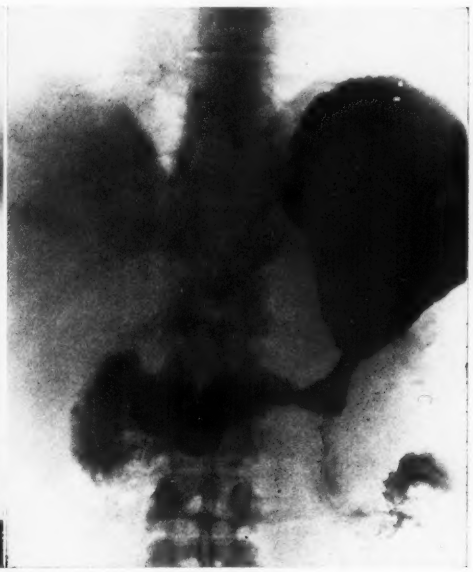

Fig. 11. Large irregular annular carcinoma of the pars media and adjacent parts of the pars cardiaca and pylorica. Marked narrowing of the lumen in the middle third of the stomach.

on the lesser curvature of the prepyloric segment it may represent an ulcerated carcinoma, according to Holmes and Hampton (5); if found on the greater curvature it has *always* been proved to be carcinomatous (Fig. 1), as so convincingly pointed out by Sproull (7). A niche on the lesser curvature near the cardia is said to be due to benign gastric ulcer, although we have had several cases of ulcero-cancer in this location—a finding which tends to refute this rule.

THE NORMAL ROENTGENOGRAPHIC APPEARANCE OF THE STOMACH

The normal stomach may take on a variety of shapes as observed in the roentgenogram. The two types referred to by Carman (8) as the "steer-horn" and "fish-hook" represent the two extremes between which any type may be found. The cardia is located just beneath the left side of the diaphragm, its dome or upper margin being smooth and often outlined by the *magenblase*, or gas bubble. Descending from this level, the lower portion of the cardia is thrown into numerous curved folds which are observed best in the partially barium-filled stomach. The esophagus joins the stomach on its lesser curvature about an inch or two from the top of the cardia. The folds, or rugæ, assume a parallel perpendicular position in the middle portion of the stomach, referred to as the pars media. Frequently the folds near the greater curvature are oblique and may cross from the posterior to the anterior wall. This portion of the stomach extends almost horizontally across the epigastrium in the steer-horn variety, and directly downward in the fish-hook, or J-shaped type. All intermediate angles are assumed in the stomach of normal appearance. The distal third, pars pylorica or pyloric antrum, contains the parallel rugæ either in a horizontal, vertical, or a combination of horizontal and vertical positions. The relief studies made with small amounts of the barium mixture reveal the condition of the mucosa to the

Fig. 12-*A*. Fig. 12-*B*.

Fig. 12-*A*. Large annular filling defect of pars media extending upward to cardia, due to an extensive carcinoma.

Fig. 12-*B*. Appearance of roentgenogram of same case shown in Figure 12-*A*, six weeks after total gastrectomy. A small external fistula persists from the line of anastomosis of the esophagus and duodenum. Note compensatory dilatation of duodenum.

best degree. The stomach terminates at the pyloric valve, the canal of which connects the most distal portion of the stomach with the first portion of the duodenum. The contour of the well-filled normal stomach from the lower portion of the cardia to the pylorus is usually indented with peristaltic waves, ordinarily two or three in number (Fig. 2). The waves begin on the lesser curvature, somewhat nearer the cardia than on the greater curvature.

SIGNS OF CARCINOMA OF THE STOMACH

Pyloric and Prepyloric Lesions.—Camp (9) states that the segment of the stomach below the incisura angularis, which is most accessible to roentgenologic observation offers more diagnostic difficulties than any other: 60 per cent of all the gastric carcinomas, 69 per cent of benign gastric tumors, and approximately 10 per cent of gastric ulcers are found within this area. The prepyloric region is also a favorite site for spasm.

The presence of irregularities along the margins of the lesser and greater curvatures in the prepyloric region is good evidence of carcinomatous involvement. This sign, however, may be found also in scar tissue changes secondary to chronic gastric ulcers. Semilunar depressions on both greater and lesser curvatures causing the lumen to be narrowed represent annular carcinomas with constriction of the lumen (Figs. 3 and 4). The large "saw-tooth" irregularity is a reliable sign which occurs in late cases (Fig. 5). Occasionally in the central portion of this type of filling defect a fleck of contrast material may be seen which represents an ulcerated portion (Fig. 6) of the tumor. A niche on the lesser curvature of the prepyloric region may be due either to a benign ulcer or to a carcinomatous one. Holmes and Hampton (5) have reported all of their cases to be carcinomatous, whereas Cole (10) holds to the opinion that less than half the number found are malignant. A filling defect on the lesser

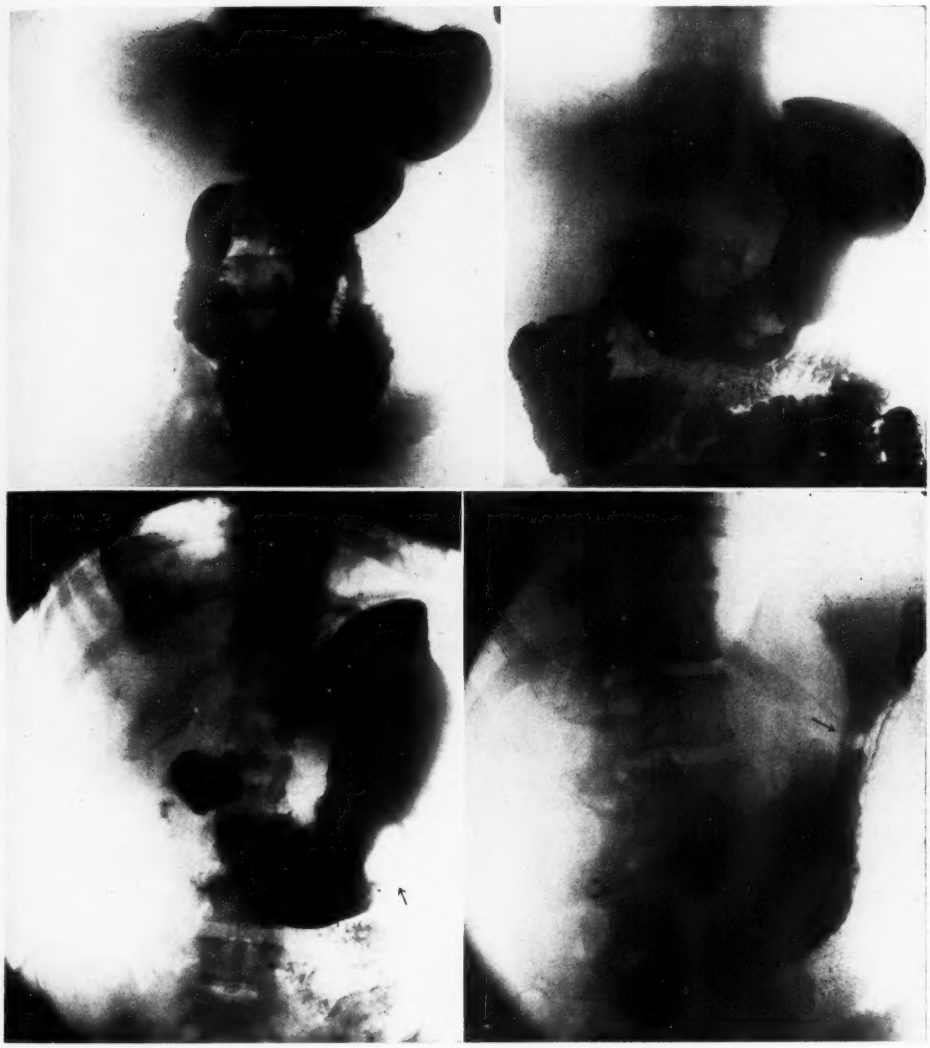

Fig. 13 (*upper left*). Annular carcinoma of pars media producing an hour-glass deformity.
Fig. 14 (*upper right*). Irregular polypoid carcinoma of the pars media producing a large defect in the lumen of the stomach. No obstruction.
Fig. 15 (*lower left*). Polypoid carcinoma in the pars media near the greater curvature producing large oval filling defect.
Fig. 16 (*lower right*). Extremely small polypoid neoplasm represented by a small circular filling defect on the anterior wall of the pars media near the greater curvature. Resection revealed adenocarcinoma, Grade II: (See case history).

curvature of the prepyloric region resembling a meniscus and produced by carcinoma has been described by Kirklin (11). Great difficulty in diagnosis occurs when pyloric stenosis is found in a markedly enlarged stomach. Usually no filling defect can be detected (Fig. 7). The differential diagnosis between peptic ulcer and carcinoma in many such instances is impossible to determine. Gastric lavage before a repeated examination is a valuable procedure to aid in the discovery of a filling defect if a carcinoma is present. The use of atropine sulphate or amyl nitrite has not been of much

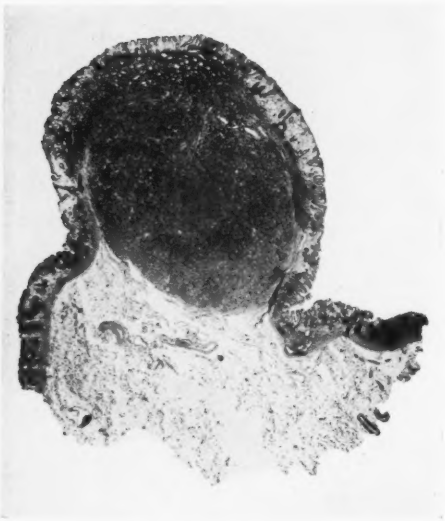

Fig. 17. Low power photomicrograph of early adenocarcinoma of stomach (see Fig. 16). Origin in base of mucosa which is not ulcerated. Note the sharp limitation of this early cancer.

value in our experience. Not infrequently a polypoid defect (Figs. 8 and 9) is found in the pyloric third and should be considered malignant until proved otherwise by microscopic examination (12). Of our series of gastric carcinomas, 97 cases, or 40.4 per cent, were located in the pars pylorica.

Pars Media.—The lesser curvature of the middle third of the stomach is the favorite site for the so-called "straight line" or "cross-bar" (13) sign of a gastric cancer (Fig. 10). The usual irregular variety of filling defect, very often annular, is the one most often found (Figs. 11 and 12). The rigidity of the gastric wall involved in cancer may be detected not only fluoroscopically, but by noting the persistence of the defect in serial roentgenograms; the peculiar contours of such irregularities, unchanged by peristalsis, remain characteristic to such a degree that on superposition of the serial films, the outline of the defect coincides exactly, whereas the uninvolved stomach has changed its shape and position on each x-ray plate (Cole).

Occasionally a real "hour-glass" configuration may be observed (Fig. 13). Not infrequently do we see polypoid cancer produce its round of oval filling defect in the central portion of the lumen (Figs. 14 and 15). There are rare instances of filling defects produced in the lumen near the greater curvature by misplaced pancreatic tissue in the wall of the stomach (Holmes). Tumors of the tail of the pancreas may produce pressure defects on the greater or lesser curvature side of the pars media (Scholtz, 14). As seen in Table I, the middle portion of the stomach is less frequently involved than either the pyloric or cardiac portions. The tumors situated on the posterior wall in the upper portion of the pars media are probably the most difficult of all stomach cancers to diagnose. Small polypoid tumors on the anterior wall can usually be detected—both fluoroscopically and radiographically—without difficulty, provided a small quantity of the barium mixture is employed (Figs. 16 and 17). In our study of 240 cases of gastric carcinoma, 15.4 per cent of the lesions were located in the pars media.

Pars Cardiaca.—The diagnosis of small, non-obstructing cancers in the cardia of the stomach is, at times, a baffling roentgenographic problem. A diagnostic handicap exists here which does not occur in other portions of the stomach, because the contrast material may surround the lesion, obscuring it from view; also, because of the difficulty in examining this fixed portion of the stomach.

The larger polypoid lesions may be detected without the use of a contrast substance, if a gas bubble is present in the stomach. The soft tissue mass presents itself as an area of increased density as related to the surrounding gas, which is of considerably lesser density. With the contrast meal, these lesions produce easily recognizable filling defects on the various aspects of the wall of the cardia (Figs. 18 and 19). Rectangular and L-shaped filling defects may also be encountered (Figs. 20 and 21). Holmes, at a meeting of the New York Roentgen Society, in 1934, pointed out that a widening of the space between the gas bubble in the cardia and the dome

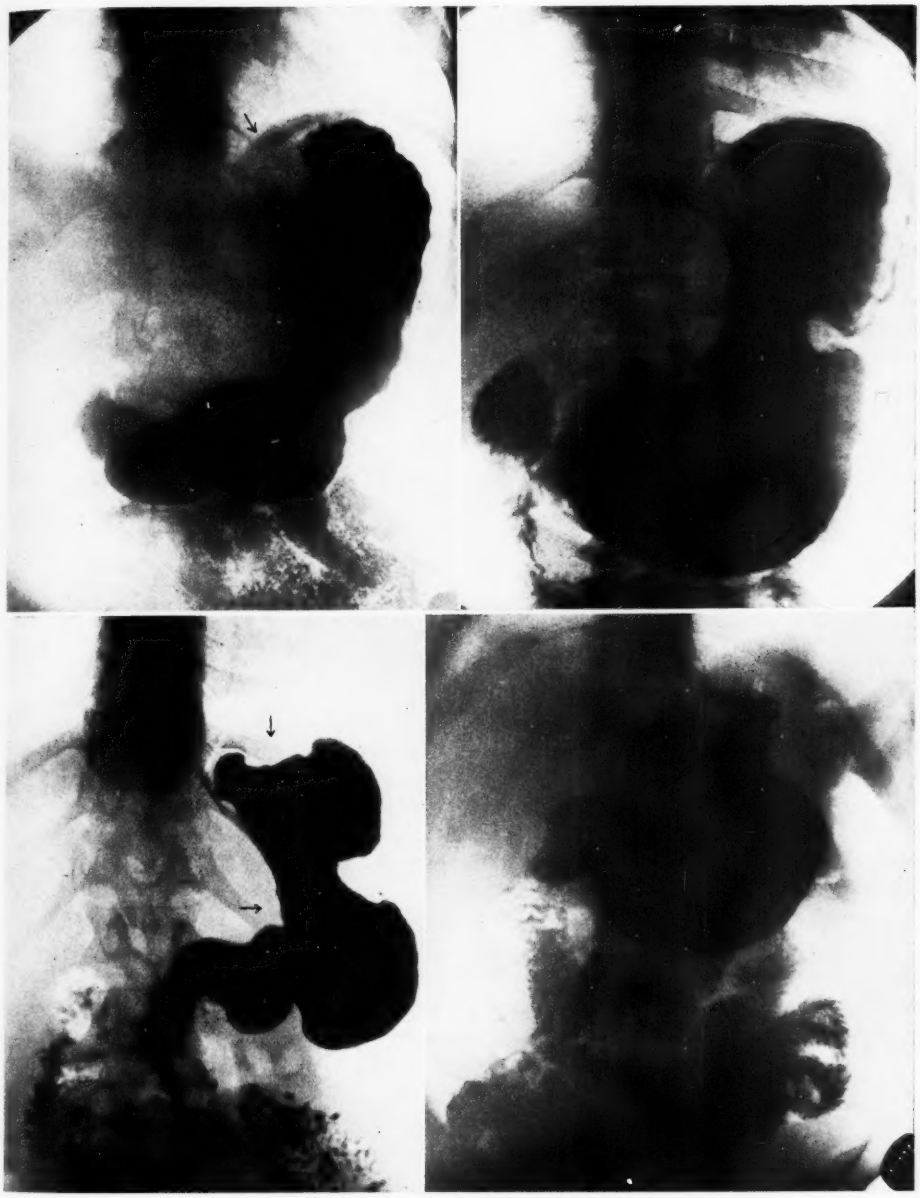

Fig. 18 (*upper left*). Carcinoma of the cardia. Large oval filling defect in the medial half of the dome of the cardiac portion of the stomach. No obstruction to flow of barium through the esophageal orifice.

Fig. 19 (*upper right*). Large, roughly circular filling defect representing the mass produced by a carcinoma of the medial portion of the cardia. Spasm of the greater curvature in the pars media.

Fig. 20 (*lower left*). Irregular rectangular filling defect in dome of the cardia and "straight-line" deformity of the proximal half of the lesser curvature. Spasm on the greater curvature of the pars media. Slight obstruction at the cardio-esophageal orifice. Operation revealed widespread metastases.

Fig. 21 (*lower right*). Large inverted L-shaped filling defect involving the dome and greater curvature, resulting from an extensive carcinoma of the cardia.

Fig. 22. Scirrhous carcinoma of the stomach causing marked diminution in the size of the lumen, rigidity of the pylorus with moderate duodenal ectasia and rapid emptying of the opaque meal. The esophagus is moderately dilated due to slight obstruction at the cardiac orifice.

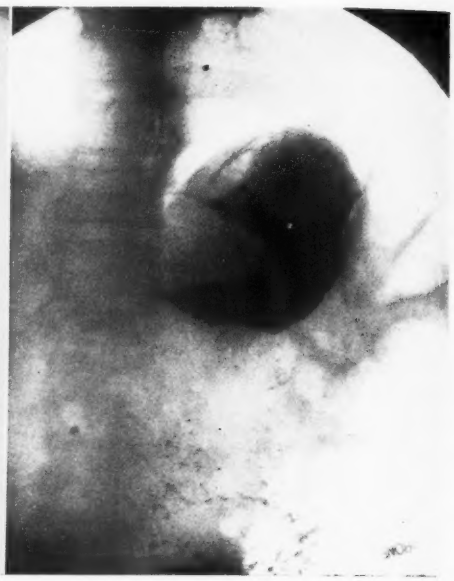

Fig. 23. Scirrhous carcinoma involving the distal two-thirds of the stomach. Annular filling defect tapering toward the pylorus. "Leg of mutton" appearance of the stomach. Diminution in the size of the lumen.

of the diaphragm may indicate a thick carcinomatous lesion in this location.

In our series of cancers of the cardia we have found a high percentage which show obstruction at the cardio-esophageal orifice as well as involvement of the distal portion of the esophagus (Table II). One may conclude from this observation that any delay in passage of the barium through the distal portion of the esophagus is to be considered due to primary cardiac carcinoma until further roentgenographic and esophagoscopic investigations prove it to be due to benign stricture, spasm, or extrinsic pressure.

Involvement of Entire Stomach.—The scirrhous type of carcinoma of the stomach, or linitis plastica, when developed to its full extent, will often involve all three portions of the stomach. The lumen of the organ is greatly diminished in size and the configuration observed with the contrast meal intact has the appearance of a "leg of mutton" (Balfour, 15) or a "retort" (Figs. 22 and 23). Peristalsis is most often absent. Usually the pyloric valve is infiltrated by tumor, which holds it patent so that no obstruction is found. Because of this fact the motility is increased, the barium passing rapidly into an ectatic duodenal blub and readily filling the remainder of the duodenum and upper small intestinal loops. Beath (16) has described four cases with similar changes and terms the entity "diffuse linitis plastica." He holds that carcinoma is the cause in every case. LeWald (17) is of the opinion that this type of stomach may be due to triple etiologic factors such as syphilis, diffuse carcinoma, and mural fibromatosis. Seven of our cases, or 2.9 per cent, showed this diffuse involvement.

Involvement of Small Area-rugal Deformity.—The diagnosis of early carcinomatous infiltrations is now made possible through the advances in technical procedures in the examination of the rugæ. Although this procedure is not new (Cole, 18), its use in recent years has taken an added impetus, especially in European countries.

TABLE I.—RADIOGRAPHIC FINDINGS IN 240 CASES OF GASTRIC CARCINOMA

Filling Defects	Number of Cases	Percentage
Pars Pylorica	97	40.4
Pars Media	37	15.4
Pars Cardiaca	56	23.4
Proximal Half	11	4.6
Distal Half	30	12.5
Entire Length	7	2.9
Absent Filling Defects	2	0.8
Total Filling Defects	238	99.0

TABLE II.—RADIOGRAPHIC FINDINGS IN 240 CASES OF GASTRIC CARCINOMA

	Number of Cases	Percentage
Absent Peristalsis	85	35.4
Obstruction	85	35.4
Dilatation	113	47.08
Six-hour Retention	116	48.3
Esophageal Involvement*	26	10.8

*Percentage esophageal involvement in carcinoma of cardia, 46.4.

Fig. 24. Leiomyosarcoma of stomach. Bulky intramural tumor originating from posterior wall and lesser curvature of stomach. Flat roentgenograms would suggest the presence of an exogastric tumor pressing against the lesser curvature. Fluoroscopy shows that (*a*) peristalsis does not pass along this border of the stomach and (*b*) palpation of the tumor reveals its intimate relationship with the barium-filled stomach. Subtotal gastric resection. Patient was living and well one year later.

Carcinoma of the Stomach without Roentgenologic Signs.—In two instances, or 0.8 per cent of the cases observed in our series, it has been found that roentgenologic signs could not be demonstrated either by screen or film examination. No filling defects, niches, or spasms could be observed and the peristaltic activity was of normal appearance (Fig. 2).

Report of an Unusually Early Carcinoma of the Stomach.—A white male, 42 years of age, was admitted to the Memorial Hospital on June 6, 1933, with the complaint of distress about the abdomen. Since the time of an appendectomy, at the age of 16, he had experienced more or less abdominal discomfort. In 1918 he had had influenza. His occupation was that of superintendent of an estate: previously he worked on a farm for seven years.

Physical examination revealed a man of stated age, in good general health. The abdomen was flat, presenting no palpable masses. Slight tenderness was elicited in the mid-line of the lower portion of the epigastrium. Two days after admission the stomach was examined roentgenologically after the administration of a barium meal. On the anterior wall of the pars media, near the greater curvature, a circular filling defect measuring 1.5 cm. in diameter was readily observed fluoroscopically and on a series of x-ray films. Otherwise the stomach and duodenum presented a normal appearance. The six-hour examination revealed no gastric retention, the barium being situated in the distal ileal loops and

ascending colon. On July 1, 1933, the colon was examined by the double contrast method for evidence of polyps, but none could be found. A second examination of the stomach was done on July 8, 1933, revealing exactly the same findings as at the time of the first study. The roentgenologic diagnosis was polypoid neoplasm (Fig. 16).

Gastric analysis done on July 6, 1933, revealed complete achlorhydria persisting after the hypodermic injection of ergamine acid phosphate.

Operation (July 11, 1933).—Under gas-ether anesthesia, a gastrotomy was performed through an upper left mid-rectus incision. Projecting from the anterior wall of the stomach in the region of the fundus, just adjacent to the pars media, a small freely movable tumor about two centimeters in diameter could be felt. On incising the stomach wall, the tumor prolapsed and then the base of the tumor was removed to include the entire thickness of the stomach wall for a considerable distance around the sessile base. The defect in the stomach wall was closed by interrupted Halstead mattress sutures of chromic catgut. Continuous braided silk serosal stitches were used for re-enforcement.

Pathological report by Dr. Ewing: Adenocarcinoma Grade II, radioresistant (Fig. 17).

Following convalescence, the patient received a high vitamin diet with yeast and large quantities of hydrochloric acid, because of his complete achlorhydria. On Aug. 14, 1933, the roentgenologic examination showed only a slight irregularity of the greater curvature at the junction of the proximal and middle portions. On Dec. 6, 1933, a check-up roentgenologic examination showed the stomach findings to be normal. Gastric analysis on Jan 25, 1934, still showed an absence of free hydrochloric acid. All specimens were negative for occult blood.

The clinical observation on Feb. 5, 1935, showed the patient to be in perfect health, and the roentgen examination of September, 1935, still showed no evidence of carcinoma in the stomach.

SARCOMA OF THE STOMACH

There are no specific radiographic features of gastric sarcoma (19). The subserosal sarcomas, particularly when pedunculated, produce no filling defects other than that caused by extrinsic pressure. Fluoroscopy aids in determining the exogastric location of such tumors. Sarcomas are far less prone than carcinomas to obstruct the pylorus and cardia; in fact, the orificial lumen in the sarcomatous stomach is frequently found to be enlarged. There are so many types of gastric sarcoma and different regions of involvement that we cannot label any radiographic sign as more than suggestive. For example, horizontal defects due to the presence of giant rugæ are sometimes present with lymphosarcoma (20). Some gastric polyps are lymphoblastic. Such a polypoid tumor may be tentatively considered as sarcomatous when peristalsis persists and passes over the area of involvement, a phenomenon probably due to late invasion of the muscular coat by sarcoma. An ulcer on the lesser curvature, in combination with a palpable epigastric tumor, usually movable, may be either carcinomatous or sarcomatous (Fig. 24).

The signs of gastric cancer may be summarized as follows:

1. Filling defects.
2. Altered pyloric function.
   (*a*) Gaping of the pylorus.
   (*b*) Obstruction of the pylorus.
3. Advanced position of the six-hour meal—hypermotility.
4. Absence of peristalsis from involved areas of the wall of the stomach.
5. Diminished mobility; loss of flexibility.
6. Diminution in the size of the stomach.
7. Antiperistalsis.
8. Niche in the prepyloric region within 2.5 cm. of the pylorus.
9. Widening of the space between the gas bubble in the cardia and the top of the diaphragm.
10. Soft tissue densities in the cardia outlined by the gas bubble; no contrast material.

11. The "meniscus" sign.
12. Absence of rugal markings.
13. Niche in relief studies without radiating rugal lines.
14. Niche on the greater curvature.

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CASE REPORTS AND NEW DEVICES

AIDS TO STEREOSCOPY

By I. SETH HIRSCH, M.D., *New York City*

Magnifying the Stereo-image.—The great service which this simple device has rendered in the reading of stereoscopic films prompts me to publish it as a technical suggestion. The magnification of the stereo-image permits the detection of very small areas of calcification, so important in the search for brain neoplasm. It also is a distinct aid in the study of the details of cranial structures, particularly those of the mastoid.

The 6-inch magnifying glasses are affixed to a small wooden plate; this is set on the top of the Wheatstone mirrors, and slides with it in adjustment.

Measuring the Phantom Image.—The other device consists of the use of transparent mirrors in the Wheatstone stereoscope, instead of the usual fully silvered mirrors. The transparent mirror permits the visualization of a measuring device inserted into the phantom, and, therefore, mensuration of any of the shadows.[1]

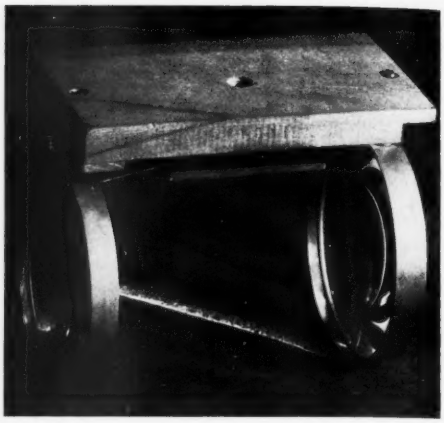

Fig. 1. Wooden plate to which is fastened two 6-inch magnifying glasses.

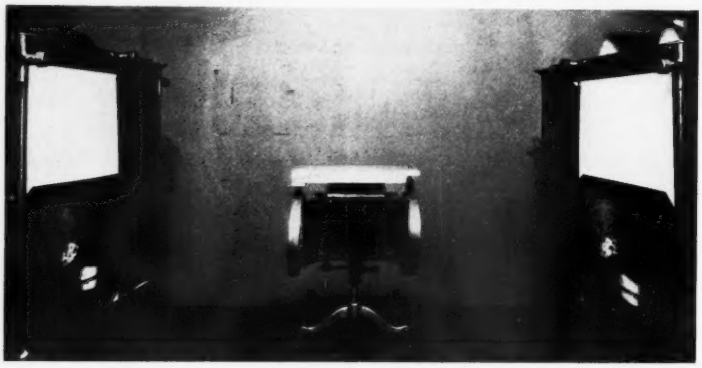

Fig. 2. A plate, with the magnifying glasses in place on the mirror carriage.

I discussed this and other methods used in pelvimetry in a paper entitled "On Thoms Method Outlining the Superior Strait of the Pelvis by X-rays" (Am. Jour. Obst. and Gynec., 1922, **4,** 316–319).

In the mensuration of the phantom, the only difficulty arises from the necessity of measuring only that image which corresponds in size exactly to the object. For one may get stereoscopic fusion and a clear image, which is either larger or smaller in size than the object itself. It also does not necessarily follow that stereoscopic fusion always gives a distortionless representation.

One method of obtaining a true image is that used by Moloy (1), and also by Johnson (2). A piece of metal of known length is stereoradiographed with the object to be studied. That image is selected for measurement, which, at the same setting of the mirrors, gives a length of shadow of the piece of metal which corresponds to its actual size.

Another is that designed by Schwarzschild. In this method a perforated strip of lead foil is placed on the x-ray table in such a way that it appears clearly at the edge in both roentgenograms. In a sleeve attached to the mirror carriage, there moves a rod tipped with a minute lighted electric bulb. It is so mounted

[1] Clear glass may be used, but the image is faint and the reflections may be annoying. In any case, the phantom should be viewed against a black background.

that it may be moved freely in a plane parallel to the imaged plane of the films, and at a distance from the observer's eye equal to that is accomplished by selecting that position of the mirror carriage which puts the incandescent filament exactly in the plane of the binocular

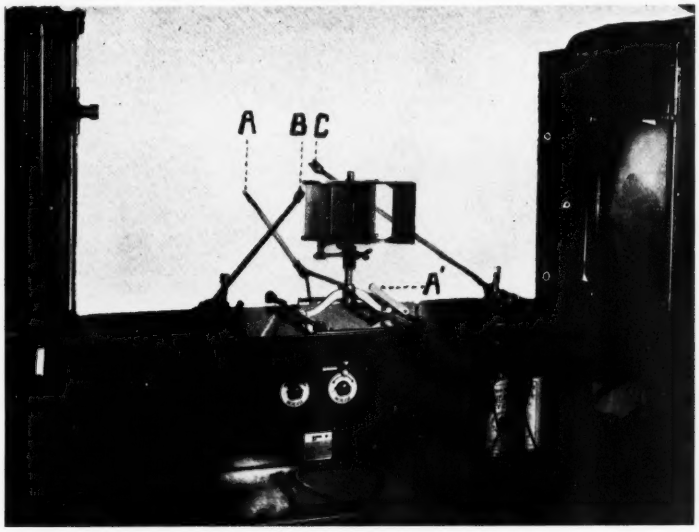

Fig. 3. A device for measuring a stereoscopic image (phantom). *A'* is a handle which controls a rod tipped with light (*A*), and used for getting a stereoscopic phantom of the correct dimensions. *B* and *C* are rods tipped with lights for localizing points for measurement. The distance between *B* and *C* may be measured by a ruler or by means of calipers.

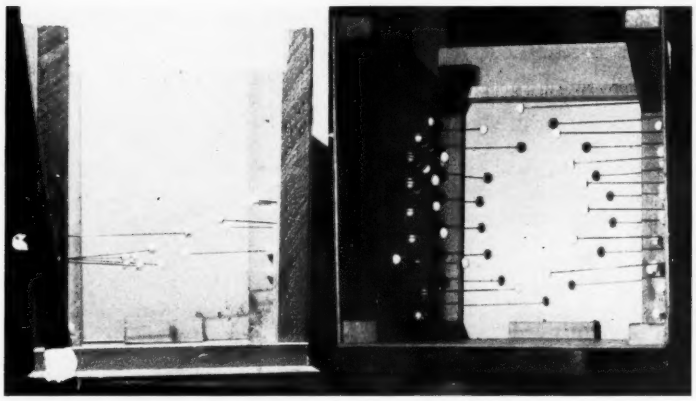

Fig. 4. Fig. 5.

Fig. 4. Cardboard box into which the phantom (stereoscopic) image is projected. The sides of the box are pierced by white headed pins. Definite points in the phantom are localized by the heads of the pins. When a sufficient number have been so placed, a contour of any plane of the object is obtained.

Fig. 5. Looking into the housing of the phantom image. The heads of the pins outline the pelvic inlet.

from the target to the table top. For correct viewing, the distance from either eye to the plane of the binocular image of the lead foil should equal the target-table distance. This image of the lead strip. This adjustment is quite critical and easily executed. Controlled by either of these methods, the stereoscopic phantom image may now be measured. The

actual measurement may be done with an ordinary ruler or an illuminated one, or by the use of two additional small filament lamps, each mounted at the tip of a rod moving in a sleeve attached to the frame of the stereoscope, one on either side of the mirror tracks. By means of the rods, the filaments of the tiny incandescent bulbs are adjusted over the desired points, and, by clamping the rods, they are firmly held in position. The distance between the filaments is then measured.

Reproducing the Phantom Image.—The actual points on the phantom image may be plastically reproduced by fixing a shot or a pin head at any desired point in the phantom and immobilizing it there. Thus a contour may be reproduced graphically.

A simple method of doing this is to construct a wooden or cardboard box, through the sides of which are pushed white headed pins (Fig. 5). The phantom stereoscopic image is then made to fall in the box. The rounded white heads of the pins are placed at the points desired, for instance, the periphery of the inlet of the pelvis, thus producing the contour of the inlet graphically and tangibly, so to speak. A similar reconstruction may also be made of the fetal head.

So also, the contour of the skull may be outlined and the position of a foreign body graphically shown.

It is perhaps needless to state that in all stereoscopic work, certain precautions are necessary. The films should be placed in the stereoscopic viewing boxes so that the distance of the eyes to the mirror image of the films is identical with the target-film distance.

The stereo-shift must equal the interpupillary distance of the observer. Under these conditions, the stereo-image is holomorphic, except for a possible error due to non-symmetrical placing of the film with respect to the tube position on the x-ray table, or to the mirrors in the stereoscope.

With ordinary care in placing the films, this error is very small (less than 2 per cent in any dimension with a target-film distance of 30 inches, and a one-inch asymmetry in the position of the films).

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OSTEOGENIC SARCOMA ARISING FROM A CALCIFIED HEMATOMA

By FRANK E. BUTLER, M.D., *and* IVAN M. WOOLLEY, M.D., *Portland, Oregon*

Case 1. Mrs. S. McG., housewife, aged 68 years, reported to Dr. A. H. Cantril, of the Bodine and Cantril Clinic, in November, 1932. Eleven years prior to this visit, she had fallen and bruised her left thigh. This injury resulted in a hematoma that did not subside but had remained as a palpable tumor. It had caused no pain or other symptoms for ten years. During the year prior to visiting the clinic, she had observed that the tumor was increasing in size, but she was otherwise symptom-free. Her history was negative for other data pertinent to this illness.

Physical examination revealed a large, nonpainful, immobile mass, lying in the soft tissues anterior to the femur. The patient was referred to the radiographic department and the following interpretation was made:

"Radiographic examination of the left thigh reveals a tumor mass, anterior to the middle one-third of the femur, which measures approximately 9 cm. in its anteroposterior depth, and 15 cm. in length. The anterior half of this mass contains dense, well organized calcium deposits which are typical of an ossified hematoma. Underlying this mass, there are calcium deposits of much less density which have the

Fig. 1. Lateral radiograph of the left thigh, showing the ossified hematoma in the anterior soft tissues. The faint calcium streaking between the denser hematoma and the femur represents the new bone laid down by the hematoma. The limiting margin of the tumor capsule is also plainly shown.

appearance of newer or more recently laid down bone salts. The femur appears to be smooth and regular.

"*Conclusions.*—This examination reveals evidence of an old ossified hematoma, with underlying new bone production strongly suggesting malignancy (osteogenic sarcoma). We are unable to positively state whether the new bone arises from the hematoma or from the femur." (F. E. B.)

An examination of the chest revealed several areas in the left lung that were strongly suggestive of beginning metastases.

The patient was admitted to the Emanuel Hospital and submitted to surgery on Dec. 3, 1932. At operation, a tumor measuring 20 × 12 × 10 cm. was shelled out of the soft tissues of the anterior aspect of the thigh without difficulty. It was not attached to the femur, and it did not infiltrate the muscle or fascia, having simply pushed them apart.

Dr. H. H. Foskett reported the pathologic examination as follows:

"*Gross Examination.*—Specimen consists of a smoothly encapsulated tumor nodule measuring 20 × 12 × 10 cm. The surfaces are lobulated, and the under surface is grooved where it has rested upon the femur. The capsule in this area, as elsewhere, is entirely smooth, and there are a few tags of fat attached to the capsule. The surfaces, made by sectioning, cut with resistance, and reveal the presence of numerous areas of calcium deposit. The surfaces are of a grayish-white appearance, with numerous flecks of yellowish pigmentation. Near the above mentioned surface, which rested upon the femur, there is a slightly different consistency, with a smooth, grayish, cellular tissue, without calcium deposits, and with no evidence of yellowish pigmentation.

"Microscopic sections taken from various areas reveal, for the most part, a fibrous tumor with numerous areas of pigment deposit from old hemorrhage and occasional calcium accumulations. There are numerous patches of active cell hyperplasia, which reveal many hyperchromatic nuclei, and rare mitotic figures. The above mentioned grayish cellular portion reveals the most active cell hyperplasia. The cells of this mass are, for the most part, small and round with rather deeply staining nuclei; they are accompanied by varying amounts of intercellular fibrillar material. Where this is present in larger amounts, many of the nuclei are elliptical. In other areas where the tissue is almost entirely cellular, there is found a great predominance of these small round nuclei, with frequent mitotic figures. There are occasional areas in which there is considerable infiltration of lymphocytes.

"Microscopic sections of the calcified areas reveal, for the most part, simple calcium deposits, although there are a few areas in which bone formation has occurred. Microscopic sections of decalcified tissue reveal true bone formation.

"*Diagnosis.*—Ossified hematoma, with malignant changes, sarcoma."

Following operation, a course of deep x-ray therapy was given over the thigh. In March, 1933, a check-up film of the chest revealed several small metastatic areas in the left lung and at least one such area in the base of the right lower lobe. A course of roentgen therapy over the chest was instituted immediately following this examination. The patient failed to return for further x-ray treatment.

In December, 1934, we received films of her chest which had been taken by her attending physician, Dr. H. V. Adix, Sr. These revealed multiple metastases throughout both lungs, with marked effusion. Her death occurred Jan. 1, 1935. No autopsy was obtained, but no further evidence of metastases had been discovered.

Conclusion.—We believe that this is a proved case of osteogenic sarcoma, arising from an ossified hematoma. Our search of the literature has failed to reveal a similar case, and we are of the opinion that it is of sufficient interest to warrant reporting.

UNUSUAL BONE CHANGES IN LEUKEMIA

By JAMES J. CLARK, M.D., F.A.C.R.,
Associate Professor, Emory University,
Atlanta, Georgia

The following case is reported from the Henrietta Eggleston Memorial Hospital for Children to illustrate an unusual example of bone and joint pathology.

M. J., female, aged 8 years, was admitted with a complaint of pain in her legs. The family history was uneventful. There was nothing of interest in her past history.

Present Illness.—In July, about three months previous to her admission to the hospital, this child had a tooth pulled and lost a large amount of blood. Fibrinogen was given by mouth. Bleeding persisted for about a week. She was quite weak and pale. Bluish discolorations appeared over her body and extremities, varying in size from a pin head to a quarter. She remained in bed for about three weeks, then got up and was about the house, still feeling badly and quite weak. She then began to vomit at intervals. This persisted until one month before admission, when she complained of pain in the lumbar region. This pain was like a "catch

in her back." It has become worse, involving first her right hip and thigh, then her left hip and thigh. For the past two weeks she has been unable to walk, and moves her legs only with difficulty. She has continuously complained of pain. There has been no known contact with tuberculosis. The patient has had no night sweats, no night cries. For the past week she has had some edema of the extremities. During the present illness there has been considerable loss of weight.

Fig. 1. Note decalcification of pelvic bones and femurs, with separation of femoral heads.

Physical Examination.—A quite pale, dull looking little girl of 8 years, who does not seem acutely ill. She is poorly nourished although fairly well developed. Her sitting posture is poor. She refuses to attempt to stand. Nothing abnormal is found in the skin, the mucous membrane, glands, head, ears, eyes, neck, or lungs. Her mouth shows several carious teeth, and the throat shows small and embedded tonsils. There is no palpable tumor mass in the neck, nor palpable glands. An examination of the heart reveals that the rate is rapid and the rhythm regular. There is a blowing systolic murmur just to the left of the sternum in the pulmonic area, which can be heard down to the left border of the sternum. The heart is not enlarged. The abdomen is symmetrical. The liver is quite large, extending three fingerbreadths below the costal margin. The spleen is not felt. There are no other masses or areas of localized tenderness. The genitalia are normal.

An examination of the lower extremities reveals that both thighs are held flexed on the hip: on passive motion she complains of pain in each on the dorsal surface just above the knee. She will straighten out the right leg on request but complains of pain on inward rotation. The muscles are flaccid on the right; on the left,

Fig. 2 (*left*). This represents the pathology existing in the case reported. Fig. 3 (*right*). Here is shown a normal femur and knee joint in a girl of the same age as the patient.

there is definite muscle spasm about the hip joint. She objects strenuously to any passive motion of the extremities. There is a slight pitting edema of both extremities below the knees. The spine is negative.

Fig. 4 (*left*). This represents a normal humerus. Fig. 5 (*right*). Showing the humerus of this patient.

The temperature on admission was 102 degrees. Laboratory studies were as follows: Blood, 40 per cent hemoglobin with 2,710,000 red blood cells and 6,130 white blood cells. Differential count was as follows: polymorphonuclears, 62; leukocytes, 33; transitionals, 2; eosinophiles, 3. Coagulation time, 6 minutes; bleeding time, one and one-half minutes. Platelet count was 140,000. Urine was negative. Blood Wassermann and Kahn tests were negative.

X-ray examinations were made of the skull, thorax, spine, pelvis, and extremities. The entire bony skeleton showed evidence of a marked disturbance in the calcium content, most pro-

nounced in the pelvis and femurs. The normal density of these structures is absent, and so much calcium has been absorbed from the pelculin test was negative up to one milligram. Serum protein was 7, with a slight increase in the proportion of albumin; this was done fol-

Fig. 6. Skull, showing multiple areas of decalcification.

vic girdle that it is only with difficulty that the borders of these bones may be seen on the films. Both femoral heads are separated from the shafts, and a pathologic fracture is present through the trochanteric area on the right. There are multiple erosions noted in the skull, ribs, and spine.

The lower epiphyses of both femurs and the upper epiphyses of both tibias and fibulas show absorption of bone and beginning separation of the epiphyses. During the later progress of her illness, the femoral epiphyses separated at the knee joints. The same process was present at the ends of the long bones of both arms.

Due to the marked disturbance in the calcium content of these bones, we suspected the presence of hyperparathyroidism. We also considered some unusual type of tumor metastases, or a parathyroid adenoma, or a blood dyscrasia.

Further laboratory studies revealed a blood calcium of 19.3 milligrams per 100 cubic centimeters. There was a blood cholesterol of 133.2. Blood phosphorus was 4.5. The tuberlowing two transfusions. Urine was negative for Bence-Jones proteins. She consistently ran a temperature between 100 and 101 degrees. Two basal metabolisms were done, with readings of plus 35 and plus 45, but the child was not basal.

During her period of hospitalization, she received a diet adequate in calcium; she had ultra-violet light, cod liver oil and viosterol, and also several transfusions. While her general condition was considerably improved, later x-ray studies showed little if any improvement in the process of decalcification.

Further studies of blood calcium were performed at Emory University Medical School, and this patient consistently ran a very high calcium level.

Her blood count varied, the red cells running between 2,000,000 and 4,000,000, the higher level immediately after transfusions. The white cells averaged around 6,150, the platelets from 40,000 to 140,000.

The history and films of this patient were re-

ferred to Dr. M. C. Sosman, of Boston, who, in turn, consulted Dr. George Holmes, Dr. Joseph Aub, and Dr. E. C. Vogt, all of Boston. They were also referred to Dr. W. A. Evans and Dr. Lawrence Reynolds, of Detroit.

These consultants did not definitely make a diagnosis, and discussed with me various conditions which might be the cause of this phenomenon. Dr. Sosman in a later communication stated that a similar case had entered the Children's Hospital in Boston, on which Dr. George Minot had made a definite diagnosis of aleukemic leukemia.

As the calcium maintained a high level in spite of dietary control, the patient was operated upon by Dr. D. C. Elkin, and a small tumor, 1.5 × 0.5 centimeters, was removed from above and behind the left thyroid lobe but not connected with it.

Pathologic study of this section failed to reveal any evidence of a parathyroid tumor.

Four days later, her white count rose to 25,800. Of this total, 69 per cent were small lymphocytes. Two days later, the white count was 26,100, with 88 per cent small lymphocytes. One day later, it was 24,100, with 96 per cent small lymphocytes, and this day the child died.

SUMMARY

This case is reported to illustrate the difficulties attending a correct diagnosis in a child who entered the hospital with a complaint of pain in her legs. The further the studies progressed, the more difficult became the interpretation.

Sufficient importance was not attached to her past history, which showed that, following extraction of a tooth, a hemorrhage followed lasting about one week with a moderate purpura.

Certain signs indicated the possibility of a parathyroid tumor, which was investigated surgically without result, but which was followed within five days by an acute exacerbation of her symptoms, at which time the true condition was easily recognized.

It also illustrates that, during an aleukemic phase, the blood studies may be practically normal. The increase in the blood calcium in this patient was interpreted to be due to a leukemic infiltration of the parathyroid gland.

We wish to give credit to Dr. E. C. Vogt, of Boston, who made the correct diagnosis before the blood findings were definite.

EDITORIAL

LEON J. MENVILLE, M.D., *Editor* HOWARD P. DOUB, M.D., *Associate Editor*

THE PRACTICE OF MEDICINE IN LABRADOR

During the Twenty-first Annual Meeting of the Society, in Detroit, an evening session was addressed, first, by Dr. Arthur C. Christie, of Washington, D. C., who delivered the Carman Lecture, after which Dr. Rollin H. Stevens, of Detroit, introduced the guest speaker, Sir Wilfred Grenfell. Dr. Stevens' introduction and Sir Wilfred Grenfell's speech are both of such interest to our members that we publish them here.

DR. STEVENS: It becomes my privilege to introduce to you one of the greatest of pioneer radiologists, yet I do not think he is generally known as a radiologist.

In 1898, Sir Wilfred Grenfell took on board his 99-ton ketch, of which he was master mariner, a small crew of men, started out from England, sailed across the ocean to the rather forbidding coast of Labrador and Newfoundland, taking with him x-ray apparatus. He hoped by this means to help in reducing the fractures and dislocations that were prevalent among the fishermen of these wild coasts.

Dr. Grenfell had been associated with the great Sir Frederick Treves, Surgeon to King Edward VII. They had done some of this work among the fishermen along the coasts of the North Sea. Then in 1892, I believe it was, Dr. Grenfell sailed for Labrador and began his work there. These small groups of fishermen were all along the coast for hundreds of miles. They had no doctor, nobody to assist them. They were suffering from scurvy, from beri-beri (I had no idea there was beri-beri on this Continent at that time), and from other nutritional diseases.

Since that time Dr. Grenfell has banished these diseases from that coast. He has established several hospitals—five, I believe—and built up nursing stations with the association of a number of doctors, nurses, teachers, and others.

Dr. Grenfell is a great medical economist, a general economist. You have just heard Dr. A. C. Christie, one of the greatest authorities on medical economics in the world, although he did not talk on that subject to-night, but Sir Wilfred Grenfell, going up among those very poor people, gave them treatment, looked after their physical wants, supplied them with food, and taught them rudimentary agriculture—he taught them how to get food other than fish to live on. These people had no money—there was no money in circulation—yet he did not do it for nothing. That is, the people did not get it for nothing.

You men go out into the clinics and you treat people who are perfectly able to pay, perhaps, and you get nothing for it. Well, Dr. Grenfell received nothing for his work personally, yet any person who gets something up in that country in the way of medical services, clothing, or whatnot, pays for it in work or in some way.

It gives me great pleasure to introduce this gentleman from Great Britain and North America.

SIR WILFRED GRENFELL: It is almost an anti-climax for a person from the North to address you after the specialist who has spoken—who is so well known to everyone and who has given us so much to think of. While I was listening to him there came into my mind the thought of how, really, every human life has to pit itself against some particular problem, if it is ever going to succeed. We who go out into the wilds where we cannot get the apparatus or the time or the support to tackle one separate problem have to remember that in our case the problem is the patient and what we are going to do for him.

We have always had to come to civilization in all times to hear anything new, and for several years, from 1892 until about 1898, when I sold my sail boat, we had to go home to England to learn anything new. We had no way of communicating for six months in the Winter and we had no way of getting to meetings of this kind—nearly all of them were being held too late for us to get to, anyway.

At that time I had never been in the United States. Of course nowadays, if you had put on the radio this lecture to which we have just listened, we could sit in one of our hospitals and hear it perfectly well.

When we began to see that our problems were connected, rather, with other aspects of human life than advanced surgery, we recognized that we had to chart our harbors on the map. Many of our troubles were due to shipwreck and to vessels being lost on uncharted shoals.

We have gradually developed a technic for getting medical men who know all about bronchiectasis and more about radiology to come down to us in the summertime. You can come to visit us now and you can bring with you your special knowledge, as Dr. Rollin Stevens did this year, because it was on account of his getting there that I am here to-night.

When, in 1894, in the rooms of my great surgical chief of nearly fifty years ago we discussed what each of us was going to do in life, our ideas were exactly the same—to carry the healing art to the wounded men across the way. It was perfectly obvious that one must cut adrift from all ideas of the purely scientific approach to medicine and surgery if one were going to Labrador.

I sold the boat and stayed in Labrador and the reason is one not easy to explain scientifically, though of late science has rather come 'round to the point of view that there is something in the other side of the matter—in the spiritual side of it—which is of great value even as a medical help in curing our patients. Certainly, it had a good deal to do with the decision I reached. There were no doctors there and a great many wounded men, and no charts, and no way of getting about. At that time we did not know that some of these diseases were curable. Dr. Stevens has been kind enough to say we have gotten rid of most of the deficiency diseases, but as a matter of fact, we have gotten rid of them because you have taught us what to do.

Of course, in England we had at that time learned what scurvy meant and how to get rid of it. We knew it was a disease needing certain vegetable salts which the natives were not getting—and did not even know about. We had the pleasure of handing that knowledge to them pretty soon. I have had the experience of sitting by a mother who, with bleeding gums and puerperic glands, was nursing a miserable, starving baby. She might be sitting right beside many of the wild vegetables and berries yet she did not know that they would save the baby and herself. We had only to tell her to go down and take the wild celery from the beach and use it and she would very soon get well. We saw many people die just from not knowing that.

Of course, this was seen when you sent us the knowledge of vitamins.

We learned that what our people needed most of all was to cultivate the land. Our problem became not so much a question of diagnosing the disease as of helping the patients to the ability of getting the remedy. After all, the viewpoint of the patient in the country, when the doctor comes to him, is, "Are you going to cure me or aren't you? I want you to give me something that can cure me."

Dr. Alexander Forbes, of Boston, has been helping me a good deal recently. He is a Professor of Research Physiology, but he has the hobby of flying. He keeps a couple of airplanes and he comes to us quite often, helping me in many ways.

Dr. Forbes has taken pictures which show how a fisherman's outfit looks—his stage, his boat, his dog pen, and his house—and you always see now a protected garden that he has made on a plot of ground fenced in from the forest—and there is plenty of forest. When you see that little fenced-in plot, it means that that family is clear of danger of scurvy or beri-beri.

I remember one time of going to a little village where there was just one family in a cove. The father was dying, the mother was very ill, and a boy of sixteen crawled out of the house and down to the water's edge, still crawling on his stomach. When I asked him why he didn't stand he said that was the one thing he couldn't do. He had a great deal of pain, but he had been afraid that I couldn't find the cottage, so he had come to meet me. When I reached the small cottage I found there three quite young children. They did not sit at the table to eat their food—they sat on the floor. The boy sat sometimes on the floor and sometimes at the table. The father and mother sat at the table.

The meals had consisted largely all Winter long of potatoes which they had been able to grow. They were English people by origin and had the habit of peeling the potatoes before cooking them.

Around the one room of the house ran a settle. Poor people there generally have but one room in which to live. There is not time to describe methods of living there, but this family put a few hens under the settle in the

Winter so they should not freeze. The family fed the hens on scraps from the table or anything they could spare to give them. In this case they gave the hens the raw potato peelings.

As the children, who were fed on the floor, never got enough food, they used to rob the hens and eat the raw peels; apparently that made all the difference between the three who ate on the floor and the three who ate at the table. We had a great many cases of that kind.

. . . . . .

I was going to speak about the various problems, especially the one referred to, of trying to make people pay for medical care. That has been a very difficult thing.

Years ago when I first built the first two hospitals—on an island—I found I could not get my patients in and I could not get them away—which was worse. They did not want to go, yet I had a limited number of beds. It chanced that I came to Boston one year and the Harvard men heard me telling of the work—there may be some of them here. One or two students who have been with me are now practising radiology. After our talk at the Students' Union, the boys asked what they could do to help me, in medicine. Of course, it was no use asking them to come and take roentgenograms for us, but they could man boats and bring the patients in and take them away. So they set to work and built a boat—that is what I told them I wanted. I described it: it had to be of hardwood on account of the ice, and it had to be a sailboat for in those days we did not trust oil engines. (I remember insisting that a man drive behind me in a buggy when I came in a car to catch a train, once upon a time. I suppose I should not say that in Detroit!)

Anyhow, the boys built the boat and they brought it to us and they aided the cause of healing patients or, rather, enabled us to heal more patients because we could get to them.

A year or two later I visited both Yale and Princeton and they also gave us boats and we have had quite a number of men from various universities—from Ann Arbor, for instance, we have had one or two good men.

Then the little nucleus of hospitals spread until we had taught our people how to build concrete and fireproof hospitals. Two burned during that time because they were built of wood, so we naturally began to teach our youngsters how to do things like building, putting in electric lights, and running water, etc., amongst many other things. Well, that resulted in some of the work that is being done there now, but all the time new things are being added.

I do not know that I can tell you much about medicine except that I was talking to an old surgeon of the early days in Boston—his name is Storer. He was telling me how, when he introduced the operation for removing the ovaries in Boston, having just come back from Germany, apparently the medical society thought it was unjustifiable. They knew little about what had just been discovered—antiseptics, etc.

However, I told him the story of my helper at the hospital and his experience one Winter. A call came from a little lighthouse which was frozen up some way from the Coast. I sent him out to get there, if he could, over the ice, which he did. He was too late for the delivery of the patient but the patient had already apparently delivered something, which he brought back. I have sent the specimen to Harvard. It was a spontaneous panhistorectomy. He brought home the uterus and one tube and both ovaries and the end of the vagina and everything else. He said the patient was doing very well.

I do not know that I ought to trespass on your time, yet in order to get our work known, of course, naturally, we have had to go and talk about it. It is the last thing that a practising doctor likes to do or ought to do. For the last few years I have not been able to do the work I would like, but I will say this: That amongst the many doctors who have come along, we have had one of your consulting eye surgeons, Dr. Joseph Andrews, who came thirteen years running. We began doing special eye work because there was a lot of trouble with eyes and none of us were especially skilled in eyes—and the eye is so important to us up there.

I was in an eye clinic in New York and after the operation I went down and said to the surgeon, "Do you ever take a holiday?"

He said, "Yes, I generally go to Europe."

I said, "If you will make it Labrador, you will be conferring a great benefit and we will put you on a salmon river or anything else you'd like in between operations."

Well, he came, and the number of people to whom he has given sight I can't say, but there are many.

We had one case that I think is *apropos* of the discussion which is coming up now—must come up, I suppose, before all medical men: that is the question of permitting us to prevent conception.

In this case I was anchored one night on a hospital boat, when a woman came aboard, bringing two parcels which she left in my chart room. When I opened them, they turned out to be twin babies—both girls—half-breeds. The woman had told me that her husband was dead—he had been killed in an accident. She did not know what to do with the babies because they were not normal. They had been born blind with posterior border cataracts.

When I asked what she was going to do with them, she said she was going to give them to me.

People say, for instance, "Why do you stay in Labrador?"

I say, "What would you do if you saw people coming to you for help and you thought you could help them? What would you do about it?"

So what could we do with the babies?

I put them on the seat in the chart room. The wheelhouse was just in front. When we got out to sea the boat began to roll about a bit and, of course, the babies began to give tongue in the chart room. The man who was in the wheelhouse, steering, put his head in the door. He looked in and he saw me, a youthful bachelor, and asked what in the name of fortune I was going to do with those two babies.

I said, "Well, when we get out to a nice open space, I am going to throw them over the side. I'm sorry you noticed them."

Well, in about ten minutes he looked in again. He was a married man, and he said, "Well, my old lady has got eight of 'em but I think she wouldn't mind two more. Don't throw 'em overboard."

Both of those children are alive now. One of them has fairly good sight. She married, and I am sorry sometimes that I didn't throw both of them overboard because that one has already produced three blind children. What am I to do with those three? Are they going to produce thirteen blind children? A blind child in a country like Labrador, with no road is a social problem, and there is nobody but me to look after them. I don't always go to fetch them but they come by mail! You may not know these things when you are dealing with the scientific phase of medicine.

We are short of many things. We are short of radium. We have the only radium north of Halifax but we have only fifty milligrams. All cancers go to Halifax and many other cases, yet our beds are overcrowded.

A Winter like this is terrible for us because some markets are closed to our fish by the Italian war. Italy is one of our markets. It is part of our problem, just as much as a dilatation of a bronchus. It leads to increased poverty and tuberculosis, one of our real and worst problems. We have to look out a little more now for some of our tuberculous cases may prove to have bronchiectasis.

I have this proposition—they want me to raise money in order to put up a sanatorium where tuberculous spines and tuberculous lungs can be taken to relieve our beds in the general hospitals. Eventually we hope to return these patients to their homes.

These are some of our problems. I can only say, looking back on my years that are coming to a close, that it has been worth while to struggle with the problems. I have had an opinion from one or two of the best men in the room to-day—I mean, best known to me. I can see that I have what is diagnosed as occluding coronary, which makes it difficult, necessarily, to drive dog teams in the Winter.

If you want a new way of travelling, that is exciting, I can assure you that driving a team of husky dogs is very exciting. After 70, however, it gets a bit difficult to do.

I want to say just this in closing, that if I had that chance again which I had in Sir Frederick Treves' consulting room in Wimpole Street nearly fifty years ago—looking at what a man gets out of life and realizing it is only what he puts into life anyway, and what he leaves to make his corner better, I should unquestionably again go to Labrador.

COMMUNICATION

RESOLUTIONS

RESOLUTION ON X-RAY PAPER

"WHEREAS, there is a tendency toward the replacement of films by paper in the interest of apparent economy, and

"WHEREAS, this is particularly true in the case of surveys of chests, and

"WHEREAS, experience indicates that the finest quality of work and detail is necessary in all types of x-ray examinations, and

"WHEREAS, the difference between the cost of paper and films forms but a small part of the cost of an x-ray examination, and

"WHEREAS, the efforts of the Radiological Society of North America should be to increase the standard of effectiveness of x-ray examination rather than to weaken it,

"Be it,

"RESOLVED, that the Radiological Society of North America disapproves the use of x-ray paper for chest purposes and other procedures requiring both detail and quality, and

"Be it,

"FURTHER RESOLVED, that copies of this resolution be sent to all National, State radiological societies, the American Medical Association, and the National Tuberculosis Association."

This resolution was adopted by the Radiological Society of North America in Executive Session at their twenty-first Annual Meeting on Dec. 3, 1935, at Detroit, Michigan.

RESOLUTION CONCERNING RADIOLOGISTS' RELATION TO HOSPITALS

"WHEREAS, proper ethical standards of a physician are essential for the securing or the retention of membership in the Radiological Society of North America, and

"WHEREAS, certain physicians have by the replacement of more ethical physicians aided certain lay groups and corporations in their attempts to practise radiology, and

"WHEREAS, such practices are inimical to the best interest of medicine, of radiology and of the radiologists concerned,

"Now therefore be it,

"RESOLVED, that it is unethical for any radiologist to replace another radiologist in an institution without the consent of the incumbent, except for cause, and provided that if cause be claimed the matter shall be referred to the Counselor for the State in which the incumbent resides, the said Counselor being hereby directed to form a tribunal to be composed of the said Counselor, a physician representing the incumbent, a physician representing the applicant and a representative of the institution involved and one additional member to be chosen by these. This tribunal shall examine the allegations and matters in controversy and shall render a decision forbidding or permitting the replacement of the said incumbent, and

"Be it,

"FURTHER RESOLVED, that violation of these rules shall constitute unethical conduct and shall be grounds for expulsion from this Society."

This resolution was adopted by the Radiological Society of North America in Executive Session at their twenty-first Annual Meeting on Dec. 3, 1935, at Detroit, Michigan.

RESOLUTION ON MEMBERSHIP CERTIFICATES

"WHEREAS, title to all membership certificates for the Radiological Society of North America is vested in the Society, and

"WHEREAS, the termination of membership in the Radiological Society of North America terminates the right to display such membership certificates,

"Now therefore be it,

"RESOLVED, that after Dec. 5, 1935, any member of the Radiological Society of North America whose membership shall be terminated, shall, upon demand by the Secretary, surrender his certificate of membership, and

"Be it,

"FURTHER RESOLVED, that this resolution be spread upon the minutes of the Society and that it be published in RADIOLOGY."

This resolution was adopted by the Radiological Society of North America in Executive Session at their twenty-first Annual Meeting on Dec. 5, 1935, at Detroit, Michigan.

RESOLUTION RELATING TO FEE SCHEDULES

"WHEREAS, The Works Progress Administration of the United States Government has published a fee schedule for diagnostic roentgenology and has included such schedule in the fee schedule for Hospital Services, and

"WHEREAS, the regional directors of the WPA are applying this x-ray fee schedule to all roentgen diagnosis whether in hospital departments or in private offices, and

"WHEREAS, this fee schedule requires that x-ray studies should be performed for the government at less than actual cost, rendering it unprofitable or impossible for private physicians to make adequate x-ray examinations for WPA employers, and

"WHEREAS, the WPA allows other physicians and surgeons fees commensurate with the value of their services, making an unjust discrimination against physicians practising roentgenology, and

"WHEREAS, this fee schedule can only result in perfunctory and restricted examinations of questionable value, to the detriment of the employees of the WPA, and

"WHEREAS, this fee schedule was promulgated with the approval of the American Hospital Association and the Catholic Hospital Association, but without the advice or consent

of the physicians who must perform this service and be responsible for the accuracy of the diagnosis and the efficiency of the examination, and therefore be it

"RESOLVED, by the Radiological Society of North America that the WPA be requested and urged to prepare and publish a fee schedule for roentgen diagnosis entirely separate from Hospital Services, which shall be just and equitable and comparable to the remuneration given other physicians and surgeons for treating the employees of this department.

"And further be it,

"RESOLVED, that this resolution be sent to His Excellency the President of the United States, the Director of The Works Progress Administration, and the American Medical Association."

This resolution was adopted by the Radiological Society of North America in Executive Session at their twenty-first Annual Meeting on Dec. 2, 1935, at Detroit, Michigan.

RECOMMENDATIONS

1. That the Radiological Society of North America reaffirm its adherence to the principles laid down at the Memphis meeting, 1934. In particular:

a. The practice of Radiology is the practice of medicine and is no more a part of the corporate activity of a hospital than is any other branch of medical practice.

b. The hospital is not entitled to any part of the net return from the professional services of radiologists.

c. Your Committee believes that the practice of radiology in hospitals should be in the hands of the physicians.

d. In hospitals wherein all members of the staff are on salary or where all members are compensated in some manner other than that outlined above, it is obvious that the radiologist should be compensated in the same manner as his medical confrères.

e. Since the personal relation between the patient and his doctor is fundamental in medical practice, any plan that tends to prevent such is detrimental to radiology. The radiologist's services should not be included in any flat rate or group hospital plan. We wish further to emphasize the dangers of the artificial division of the x-ray examination into so-called technical and professional portions and it is our conviction that the integrity of radiology cannot be maintained under such division.

2. That this Society, composed of more than eleven hundred members of the American Medical Association, make strong representations concerning those matters to the responsible officers and especially the Council on Medical Education and Hospitals of that Association, with the request that it support officially its members.

3. That this Society officially offers to the American Medical Association and its various Councils and Bureaus the benefits of the Council's advice and experience of the Radiological Society of North America to the end that the problems which affect the practice of radiology may be fully understood and decided on a basis of correct information.

4. That this Society appoint the Radiologists-Hospital Committee as its liaison with the American Medical Association and the National Hospital Associations and give to it power to act in furtherance of all the above-stated principles.

5. That this Society make strong representations to the American Medical Association, the American Hospital Association, the Catholic Hospital Association and the American Protestant Hospital Association, pointing out the danger of any attempt to divide radiology or any branch of medical practice into so-called technical and professional portions.

6. That the Society instruct and authorize the Executive Committee to expend such moneys as it may deem needful to expedite these matters.

This report is respectfully submitted.

THE RADIOLOGISTS-HOSPITAL COMMITTEE

The above recommendations, which were a part of the report of the Radiologists-Hospital Committee were presented to the Radiological Society of North America at the twenty-first annual meeting held in Detroit, Michigan, on Dec. 2, 1935.

The entire report was accepted and the recommendations concurred in.

IN MEMORIAM

WILLIAM L. CLARK, M.D.

Dr. William L. Clark, of Philadelphia, distinguished pioneer of electro-surgery, died of biliary disease at his home, Jan. 12, 1936, after

an illness of three months. Dr. Clark was born at Honesdale, Wayne County, Pennsylvania, July 30, 1876, son of Mr. and Mrs. Edward C. Clark. He was a descendant of an old Colonial family.

His early education was obtained in the Honesdale schools, where he taught for several years after graduation. Pursuing his ambition to study medicine, he entered Niagara University, and later matriculated at the University of Pennsylvania Medical School, from which he received his degree in 1903. His internship was served at St. Joseph's Hospital, following which he entered upon private practice.

He was very active in writing and presented numerous papers on the use of the electro-thermic method. He was always anxious to teach others the technic, and was never happier than when demonstrating it to a group of physicians. It was quickly taken up by others and its use has spread throughout the world. His contributions to medical literature have appeared in the foremost medical journals, not only of this country but abroad. He contributed a chapter on electro-surgery to Da Costa's text-book on surgery; a chapter on electro-surgical methods to the "Principles and Practice of Physical Therapy," by Mock, and one on the same subject to "The System of Surgery," by W. W. Keen.

In 1923, Dr. Clark opened a private hospital at 23rd and Walnut Sts., Philadelphia, for the treatment of malignant disease. As a pioneer in the use of radium and the x-ray, he was one of the first to use the divided dose technic in x-ray and never departed from this, even in the days when massive doses of x-ray were in vogue.

He was one of the leaders in physical medicine and surgery, and has been honored by the presidency of the American Physical Therapy Association, the American Congress of Physical Therapy, and the American Academy of Physical Medicine. In 1933, he was presented with the Gold Key of the American Congress of Physical Therapy and had the honorary degree of Fellow of the American Academy of Physical Medicine conferred upon him by that organization. He was a Fellow of the American Medical Association, a member of the Pennsylvania State Medical Society, Philadelphia County Medical Society, Philadelphia Medical Club, American Radium Society, American Roentgen Ray Society, Radiological Society of North America, and the Philadelphia Dermatological Society.

Dr. Clark was at one time on the staff of St. Agnes Hospital, St. Mary's Hospital, and Jefferson Hospital. He was lecturer on physical therapy at Jefferson Medical College for a number of years.

Dr. Clark's contribution to medicine and surgery obtained for him a foremost position, not only in the United States but abroad. His determination to complete an undertaking once started in a large measure accounts for his success. His outstanding ability as a teacher was evidenced by the interest displayed by students in the medical school, and by the eagerness with which his fellow-practitioners sought knowledge from him. His personality and courtesy were such that all who sought, received abundantly of his knowledge. His influence on the development of physical therapy was inestimable and his perfection of the electro-thermic method has been one of the great advances in surgery in modern times. His host of friends and patients lament his passing.

He is survived by his widow, Mary McMahon, four sons, David, William L., Jr., Edward, Robert, and two daughters, Nancy and Margaret.

BOOK REVIEW

THE HUMAN FOOT: ITS EVOLUTION, PHYSIOLOGY, AND FUNCTIONAL DISORDERS. By DUDLEY J. MORTON, Associate Professor of Anatomy, College of Physicians and Surgeons, Columbia University. A volume of 244 pages with 100 illustrations. Published by Columbia University Press, 2060 Broadway, New York City, 1935. Price: $3.00.

The work is distinctly new in its concept when compared to the usual type of orthopedic text-book. The author has taken a part of the human anatomy, the foot, and developed its story completely—a more complete study could hardly be asked for. The evolution of the foot with its component parts is a highly interesting subject in itself. Well covered by the author though not in so much detail as to be tiring, it should serve as an instructive treatise on this part by all who have an interest in the subject.

After developing the subject of the evolutionary development of the physiology of the human foot he proceeds to the physiology of the human foot. Here he gets into a little deeper water, at least so it would seem to the average reader. However, this phase of the

subject is well covered. This is done to develop a clearer understanding of his theories regarding the disorders underlying the ailment of the foot commonly seen in human beings.

Unlike many treatises on the anatomical and physiological development of the human body this author goes on to a comprehensive description of the disorders of the foot and their treatment. Some of the author's theories regarding the underlying causes are new to us. The importance of the shortening of the first metatarsal and hypermobility of the first metatarsal segment are not usually stressed as this author has done. Because of the well developed theory, backed up by clinical observations, this concept should be borne in mind by others and an attempt made to evaluate it.

All in all, we feel that we have read the most complete and at the same time the most readable dissertation on the development and disabilities of the human foot that has been printed in the English language.

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ANIMAL EXPERIMENTATION

Results of Experimental Irradiation of the Ovary and Kidneys in the White Rat. E. Fels. Strahlentherapie, 1935, **54**, 279.

The author determined experimentally the castration dose for the ovary of the white rat at approximately 3,000 r. He found that the corpora lutea are radioresistant. The most accurate test for complete castration is the histologic study of the hypophysis and the ovary itself. The changes observed in the vaginal mucosa in connection with the estrual cycle are not reliable indicators. It was also found that the kidneys are severely injured by the castration dose; both tubuli and glomeruli show degeneration. It is questionable, however, if the function of a kidney can be completely destroyed by irradiation. The use of radiation therapy in non-healing fistulæ of the ureter can, therefore, not be supported by experimental evidence.

ERNST A. POHLE, M.D., Ph.D.

APPARATUS

Tomography: Roentgenography of Selected Body Planes. G. Grossmann. Fortschr. a. d. Geb. d. Röntgenstrahlen, 1935, **51**, 61–80.

The idea of what is now called tomography was conceived by A. E. M. Bocage, in 1921, and practised for years by B. G. Fiedses des Plantes and D. L. Bartelink. This method of roentgenography during the exposure shifts tubal focus and the film in opposite directions and in mirror-image equal movements, so that a selected body plane casts a clear-cut image, while all other planes, whether closer to or farther removed from the determined plane, are eliminated by the motion of focus and film. The paper gives a theoretical consideration of the method and the various partly rather complicated procedures and devices used by a number of workers. It also describes in some detail a simplified apparatus experimentally used by Prof. Chaoul in the surgical department of the Charité Hospital at Berlin. One does not gain the impression, however, that this apparatus represents the final solution of the most interesting technical problem, deserving of consideration. Several "tomograms" of heart, atlas and axis, petrous bone, and sternum illustrate the technical gain of rather clear pictorial demonstration of selected levels with elimination of all confusing other levels.

One should keep in mind that, with this method and equipment, certain detailed questions may be attacked advantageously, but that it will not eliminate roentgenography and its evaluation as commonly practised; that, if unduly emphasized, it may lead to disastrous oversights. Nevertheless, it is of distinct theoretical and practical interest.

H. A. JARRE, M.D.

ARTHRITIS

Some Unusual End-results of Gonococcal Arthritis. Gianbattista Cottini. Archivio di Radiologia, March-April, 1935, **11**, 165–184.

The author discusses in detail three cases of gonococcal arthritis followed roentgenologically. Two of them were later complicated by calcification of the joint and one by myositis ossificans.

E. T. LEDDY, M.D.

BONE DISEASES

Acromegaloid Osteosis. G. von Pannewitz. Röntgenpraxis, October, 1935, **7**, 682–686.

Only six cases of acromegaloid osteosis have been described. The roentgenologic differentiation of it from acromegaly and hypertrophic osteo-arthropathy is definitely possible. The sella turcica shows no changes in these cases. Skull, jaw, and alveolar processes lack the findings present in true acromegaly. The phalanges are not widened. Osseous changes in forearms and legs are typical, consisting of a gross thickening of only these bones, with massive periosteal apposition and a rough surface. Not only are the soft tissues of hands and feet thickened, but also of scalp and face, which is another clinical point of differentiation.

HANS W. HEFKE, M.D.

Carcinomatous Metastases in Bone. J. Borak. Med. Klinik, June 14, 1935, **31**, 782–785. (Reprinted by permission from British Med. Jour., Oct. 12, 1935, p. 55 of Epitome of Current Medical Literature.)

Since 1924, the author has been especially interested in the x-ray therapy of cancerous metastases of bone. From his experience of over 200 cases he draws several conclusions: (1) The spine is more frequently the seat of metastases than the ribs or skull; in the spine the lumbar, dorsal, and cervical segments are affected in that order. (2) The breast is responsible for 70 per cent of all cases of bone metastases. Cancers of the prostate, thyroid, and adrenals follow in that order of frequency. Glandular organs thus seem to predispose to bony metastases, although the secondaries are more often of the simplex than of the adenomatous variety. (3) A kind of antagonism between bone and internal organs seems to exist, for when secondaries occur in the internal organs the bones often remain immune, and *vice versa*. (4) Metastases in bone are comparatively benign; their chief symptom is pain, and occurs late. The pain is at first intermittent and slight, and later becomes continuous and intolerable. The patient becomes bedridden, and usually succumbs to pneumonia. (5) Borak's results from x-ray therapy of bony metastases are very encouraging. Clinically, he was able to relieve intolerable pain, which previous to radiation had necessitated large doses of morphine. In x-ray films and at postmortem he has been able to demonstrate anatomical cure. Secondaries in bone are more sensitive to radiation because of the lack of epithelial tissue in it. However, as in tumors elsewhere,

bony metastases which have been previously irradiated and have not retrogressed completely are less amenable to secondary irradiation than those irradiated for the first time. Especial care in the technic of the first course of irradiation is, therefore, necessary.

BONE GROWTH

The Influence of Dose and Rhythm on the Degree of Injury to Bone Growth Following Roentgen Irradiation. A. Baunach. Strahlentherapie, 1935, **54,** 52.

The author studied the effect of roentgen rays on the growth of bones in rabbits in relation to the age of the animals, the dose applied, and the rhythm (distribution of the dose) of the treatment. Deep therapy radiation (185 kv., 0.5 mm. Cu) was used; the dose at one single sitting varied from 55 to 330 r. The fractional doses were as high as 5 × 330 r given in 10 days. One entire hind leg of the rabbit was irradiated. It appeared that young animals were more susceptible. The effect of fractional doses was less than if the same total dose had been given in one sitting. The inhibition of growth increased with increasing doses. Microscopical studies of the irradiated bones showed that up to 275 r no definite changes could be detected up to six months after the exposure. Following 330 r in one sitting and from 880 to 1,650 r in fractional doses there were definite signs of injury six months after the treatment. Necrosis of cartilage was seen only in one case following doses of 1,650 r.

ERNST A. POHLE, M.D., Ph.D.

THE BRAIN

Hematoma duræ matris ossificans. Arthur Schuller. Fortschr. a. d. Geb. d. Röntgenstrahlen, February, 1935, **51,** 119–124.

Referring to a detailed review of Pachymeningitis hæmorrhagica interna, by E. Schneider (Zentralbl. f. d. ges. Neur. u. Psychiat., 1934, **70,** 1–19) and to a paper by Leary on Subdural Hemorrhages (Jour. Am. Med. Assn., Sept. 22, 1934, **103,** 897–903), the cystohemorrhagic type of the disease is regarded as offering particular interest to the roentgenologist. Encapsulated hemorrhages can form characteristic calcifications and ossifications, readily demonstrable in roentgenograms as sharply delineated shadows in the circumference of the brain or its lobes. Shifting of the pineal body or a calcified segment of the falx and also encephalographic manifestations can aid in the diagnosis. There are illustrations of four cases and two specimens with short case reports.

H. A. JARRE, M.D.

The Ventriculographic Prediction of the Type of a Brain Tumor. Herbert Peiper. Fortschr. a. d. Geb. d. Röntgenstrahlen, February, 1935, **51,** 113–118.

Determination of the type of a brain tumor would be desirable in order to institute the most advantageous therapeutic measures. From the author's experience, however, such predictions on a ventriculographic basis are not possible, as illustrated by a number of observations. It also is shown that a clinically manifest and localizable brain tumor may be temporarily devoid of ventriculographic symptoms, yet produce striking changes in a short interval, so that in the presence of clinical suspicion, repeated ventriculography may be indicated.

H. A. JARRE, M.D.

BURNS AND INJURIES

Acute Death Following Radium Therapy in Gynecology. L. Nurnberger. Strahlentherapie, 1935, **54,** 525.

Acute fatal injuries following roentgen therapy are very rare; radium therapy must be considered more dangerous in this respect. A series of cases observed during the treatment of gynecologic disease are analyzed by the author. He concludes that in radium therapy of carcinoma of the uterus, septic complications may occur, but, in addition to those, death is sometimes due to an acute or subacute breakdown of the circulatory system. Its cause is not well understood. Old women with heart disease constitute the majority of these cases. In establishing the indication for radium therapy this factor should be carefully considered.

ERNST A. POHLE, M.D., Ph.D.

The Development of Malignant Tumors Following Roentgen Sterilization. E. Vogt. Strahlentherapie, 1935, **54,** 570.

The author reports three cases of malignant tumors developing in the uterus or ovary in women who had previously undergone roentgen sterilization. Although no relationship could be established between roentgen sterilization and tumor, the author emphasizes again that a diagnostic curettage is imperative in all patients who are to receive roentgen or radium therapy for uterine fibroid or uterine bleeding of non-malignant origin. If after successful roentgen sterilization the bleeding recurs, one should consider a malignancy unless proved otherwise. There is, however, no reason to discontinue the use of roentgen rays or radium in treating uterine fibroids.

ERNST A. POHLE, M.D., Ph.D.

A Rare Case of Late Injury Following Roentgen Therapy. F. Voltz. Strahlentherapie, 1935, **54,** 574.

The author observed a very interesting late injury following roentgen therapy which eventually developed into carcinoma. The patient, a 29-year-old soldier, was treated in 1917 for tuberculous glands in the neck. He received two series of treatments. In the first series 10 per cent of the H.E.D. was given nine times at intervals of two weeks (filter, 3 mm. Al). In the second series he received a total of 70 per cent H.E.D., with intervals of three weeks between single sittings, through a filter of 0.6 mm. Zn. A slight pigmentation was seen after the second series. Early in 1919, an ulceration was seen around the neck 3 cm. wide, and

extending throughout the treated field. This was explained on the basis of mechanical irritation from the high collar of the uniform. It healed promptly under adequate treatment. The patient was a very enthusiastic Alpinist and, while climbing mountains, received several severe sunburns which included also the cervical regions. Early in 1930 an extensive ulceration developed in the irradiated areas, which were treated by a "homeopath," who, among other things, massaged the surrounding tissues. The condition grew worse and, in 1933, a surgical consultation revealed a huge inoperable carcinoma which did not respond to radiation therapy. The patient died in 1934. The author reports this case to show the relation between late injury, mechanical and actinic irritation.

ERNST A. POHLE, M.D., Ph.D.

CALLUS, PAROSSEOUS

Regarding the Treatment of Parosseous Callus by Roentgen Rays. O. Dyes. Strahlentherapie, 1935, **54,** 386.

Callus developing in the muscles of the upper arm and thigh following injury to either bone or muscle is usually painful and limits motion of the involved member. The author recommends x-ray therapy in this condition: 180–212 kv., 0.5 mm. Cu + 1.0 mm. Al, 20 × 24 cm. field, 50 cm. F.S.D., 30 per cent H.E.D. per sitting, to be given six times at intervals of from 7 to 10 days. Roentgenograms of one successfully treated case are appended.

ERNST A. POHLE, M.D., Ph.D.

CANCER (THERAPY)

Results of Radiation Therapy in Operable Carcinoma of the Breast. R. Glauner. Strahlentherapie, 1935, **54,** 420.

Fifty cases of inoperable carcinoma of the breast were subjected to radiation therapy in the author's clinic. Forty-one of these patients were primarily inoperable and nine because of secondary causes (age, heart, or kidney disease). After three years 22 per cent, and after four years 10 per cent, survived. Two of the cases have been free from recurrences for four and one-half and four and three-quarters years, respectively. A table gives more detailed data on the nine cases of Stage I, correlating age, reason for inoperability, treatment data, clinical course, and duration of observation.

In conclusion, the author states that even in advanced cases of carcinoma of the breast adequate radiation therapy may produce satisfactory results beyond the usual palliation.

ERNST A. POHLE, M.D., Ph.D.

Radiation Therapy of Carcinoma of the Mouth. F. Perussia. Strahlentherapie, 1935, **54,** 1.

The author, who is Professor of Radiology at the University of Milano, Italy, presented this report before the Fourth International Congress in Zürich. Following an analysis of the statistics comparing end-results of surgical and radiological treatment in carcinoma of the mouth, he outlines the indications for the use of each treatment method. Not all inoperable cases should be submitted to irradiation, since there is a definite limitation for the usefulness of radiation therapy. Histologic examination of specimens removed at biopsy is important for the determination of the proper treatment technic. The author recommends surgical removal of cervical glands even if there is no definite involvement. Radionecrosis occasionally occurs following radiation therapy of carcinoma of the mouth; its characteristics and treatment are discussed. He also appends his personal statistics from 375 cases of buccal carcinoma treated during the period from 1928 to 1933. There are also 36 illustrations showing patients before and after treatment.

ERNST A. POHLE, M.D., Ph.D.

A Preliminary Note on Low Voltage X-ray Therapy. Woodburn Morison, D. Hugo, and W. V. Mayneord. British Med. Jour., Oct. 26, 1935, No. 3903, 783, 784.

While much attention has been paid to the development of higher voltages in x-ray therapy, advances have been made in the field of low voltages. "Shock-proofing" and standardization of dosage have aided in broadening the field for this new form of therapy. Schaefer and Witte, and Sauerbruch, Chaoul, and Adam have contributed to the advances in this form of roentgen therapy. The authors have employed this method in the treatment of 40 cases, and while they believe it possesses some advantages, their experiences are too recent to judge the final results.

The authors employed a low voltage plant of the type used by Chaoul, in which the x-rays were generated at a constant voltage of approximately 60 kv., with 4 ma. tube current. The source of radiation is located at one end of an earthed metal tube. The rays emerge through the target of gold-plated nickel and the water-cooling jacket. These are the only filters employed and are equivalent to approximately 0.2 mm. of nickel. The mean wave length is about 0.32 Å.U. With a 5 cm. focal-skin distance and a 4 cm. diameter circular field, the depth doses along the central ray are as follows: 1 cm. depth, 68 per cent surface dose; 2 cm. depth, 44 per cent surface dose; 3 cm. depth, 29 per cent surface dose; 4 cm. depth, 19 per cent surface dose. The dosage rate in air at 5 cm. focal-skin distance is approximately 110 r per minute. This is increased to 130 r per minute by "back-scatter."

The authors used a daily dose per field of 400 r, although this was varied depending upon the reaction of the lesion. A mild erythema of the normal skin surrounding the lesion was noted on the fourth day. The total dosage per field varied from 5,000 to 6,000 r spread over a period of about fifteen days. Because of the small field treated the patient suffers no constitutional effects of the treatment. Several fields may be treated per day since 400 r are obtained in about three minutes.

Skin cancers have been treated by the authors with

this form of therapy with distinct advantage over the other forms. In buccal cancer, because of the small field irradiated the usual action of the x-rays upon the salivary glands was avoided. This method of therapy was found to have a limited field of usefulness in mammary cancer and was used in the fulminating stage of this condition and for the treatment of the small postoperative recurrent nodules. Witte and Schaefer have used this form of therapy with slightly different technic in the treatment of over a hundred cases of cervical carcinoma with results comparable to those obtained following the use of radium.

J. N. Ané, M.D.

CONTRAST MEDIA

Observation on a Rare Case of Late Abscess Caused by a Spondylitis Typhosa and the Roentgenologic Demonstration of It. Ernst Wagenfeld. Röntgenpraxis, October, 1935, **7**, 672–677.

A large retroperitoneal abscess was found in a woman fifteen years after a typhoid spondylitis. Stereoscopic films after lipiodol injection allowed an accurate anatomical localization of the abscess pockets. The extent and route of the abscess could be followed in this way. Even after six months, there was still some contrast material in portions of the abscess.

Hans W. Hefke, M.D.

THE DIAPHRAGM

The Outline of the Diaphragm, with Special Reference to its "Pinching." S. M. Gliozzi. Archivio di Radiologia, March-April, 1935, **11**, 117–126.

The author shows some roentgenograms of the diaphragm under normal and pathologic conditions, with special reference to pneumothorax, which may give it this tent-like appearance.

E. T. Leddy, M.D.

DOSAGE

A New Determination of the r for Gamma Rays. W. Friedrich and R. Schulze. Strahlentherapie, 1935, **54**, 553.

The authors determined again the four equivalents of 1 mg.-hr. of radium filtered through 0.3 mm. Pt + 1.5 mm. brass at 1 cm. distance. They arrived at the value of 7.6 r, which is in good agreement with previous measurements, resulting in the value of 7.5 r. The measuring method is described in detail.

Ernst A. Pohle, M.D., Ph.D.

THE ESOPHAGUS

Esophageal Obstruction. H. S. Souttar. British Med. Jour., Oct. 26, 1935, No. 3903, 777–779.

The author discusses carcinoma and cardiospasm as the two most important causes of esophageal obstruction.

Carcinoma of the esophagus is more common in elderly men after the age of 50 years. Women are usually affected after the age of 40 years. While its usual location in the male patient is in the lower third of the esophagus, in the female it may occur in any location, with a large number of the cases arising from post-cricoid growths.

The first and most prominent symptom observed in carcinoma of the esophagus is a steadily increasing dysphagia which is later associated with regurgitation. The secretion of a stringy, tenacious, frothy mucus occurs which is at first white and odorless and later blood-stained and foul. With involvement of the respiratory system, symptoms referable to these organs are noted.

The roentgen examination of the esophagus is of great value in the diagnosis of carcinoma. Fluoroscopic examination shows that the passage of the barium column is stopped in the region of the lesion. If the obstruction is not complete the bariumized fluid then will be seen to pass slowly through the fine, tortuous passage produced by the growth. A moderate degree of dilatation will be noted in the region just above the stricture, terminating in a cone, directed downward.

The author suggests intubation for the relief of these cases of dysphagia due to carcinoma of the esophagus. He employs a tube in the form of a flexible spiral formed of German silver wire. The tube is introduced by means of an esophagoscope, after preliminary dilatation by means of special dilators devised by the author.

Dysphagia is about the only feature that carcinoma of the esophagus and cardiospasm have in common. Cardiospasm occurs in younger individuals and frequently in individuals having a nervous disposition. It may appear after a severe shock or as a sequel to some illness. The patient usually complains of regurgitant vomiting rather than dysphagia. Roentgen examination of cardiospasm shows evidence of a dilatation of the esophagus, which may be enormous, and which terminates abruptly at or near the cardia. While the obstruction may be complete, more commonly after the barium column has reached a sufficient height to exert sufficient pressure the barium meal may be seen passing into the stomach. There may be evidence of an irregular peristalsis which fails to advance the column.

Cardiospasm is primarily due to spasm of the circular fibers at the lower end of the esophagus. The rôle of the diaphragm in this condition is unknown. Knight's experiments have shown that the cardiospasm is due to an over-action of the sympathetic fibers which control the whole region of the cardiac orifice. The author has confirmed this work by obtaining relaxation of the cardia in patients, after splanchnic anesthesia.

Knight demonstrated that a large portion of the sympathetic supply to the cardiac orifice is carried on the coronary artery, and suggested excision of this artery in the treatment of cardiospasm. The author has employed this form of therapy in two cases of cardiospasm and was thus able to relieve the patients. However, x-ray examination showed some spasm remaining after this procedure was carried out.

J. N. Ané, M.D.

FISTULAS

Post-operative Fistula between the Common Duct and Colon. Josef Meese. Röntgenpraxis, October, 1935, **7,** 690–692.

Fistulas between the common duct and colon have been reported by surgeons and pathologists, but very rarely by radiologists. Such a case is here described.

In a patient who complained of diarrhea and indigestion two and one-half years after a cholecystectomy, roentgenograms of the colon showed a fistula between the transverse colon and the common duct. The entire hepatic duct system filled with barium after a barium enema. An important roentgenologic point is to look for air in the hepatic ducts even before barium finds its way into the fistula.

HANS W. HEFKE, M.D.

THE FOOT

Fracture-like Changes of the Second Metatarsal in Children. Arnold Herzog. Röntgenpraxis, September, 1935, **7,** 601–603.

The author had an opportunity to see changes in the second metatarsals in three children between 5 and 7 years of age, which correspond completely with the so-called "marching fracture." Without a history of direct injury, there was pain, and roentgenograms showed a fine transverse break in the continuity, and later callus. The cause of the short duration of symptoms is to be explained by the faster regeneration in children. Any other explanation, as embolic infection, necrosis, etc., seems doubtful.

HANS W. HEFKE, M.D.

GALL BLADDER (NORMAL AND PATHOLOGIC)

Clinical Study and Pathology of Diverticulum of the Gall Bladder. Heinrich Hartmann. Fortschr. a. d. Geb. d. Röntgenstrahlen, July, 1935, **52,** 30–36.

This is the report of a case of fist-sized calcifying diverticulum of the gall bladder successfully removed at operation after roentgenologic demonstration. It is assumed that such diverticula of the gall bladder develop from hypertrophic ducts of Luschka.

H. A. JARRE, M.D.

GASTRO-INTESTINAL TRACT (DIAGNOSIS)

The Value of Roentgenologic Investigation in Unusual Complications of Diseases of the Alimentary Canal. Josef Pinke. Fortschr. a. d. Geb. d. Röntgenstrahlen, March, 1935, **51,** 261–273.

The author reports five unusual cases: (1) A prepyloric gastric polyp which during roentgenologic investigation became temporarily incarcerated in the duodenal bulb; (2) A large abdominal abscess between stomach and liver anterior to the spine, arising from a perforated gastric ulcer near the cardia and containing fluid and gas; (3) A symptomless gastrocolic fistula produced by a saucer-shaped gastric carcinoma of the size of the palm of the hand; (4) Multiple diverticula of duodenum, jejunum, and ileum, and (5) a large diverticulum in the location of the papilla of Vater, with a malignant fibroma arising from its wall, bleeding from which finally led to this patient's death.

H. A. JARRE, M.D.

GENITO-URINARY TRACT (DIAGNOSIS)

Urologic Injuries. Meredith F. Campbell. Am. Jour. Surg., November, 1935, **30,** 327–341.

The author discusses briefly the various important phases of injury of the urogenital apparatus, with items of medico-legal interest kept in the foreground. From the legal aspect the importance of obtaining an accurate history of the nature of the injury and the circumstances leading up to it are particularly important. Frequently the condition of patients urologically injured is so grave that good surgical judgment permits only a casual physical examination rather than a complete urologic investigation. Excretory urography gives the most valuable roentgenographic information concerning injuries of the kidney, ureter, and bladder. The advantages of conservative surgical treatment in a large proportion of urologic injuries should be kept in mind. Yet the surgeon must be alert to the indications for prompt and radical intervention. Operative speed is imperative. The patient should not be allowed to die of shock or hemorrhage, either while we attempt to establish an accurate minute anatomic diagnosis preoperatively or by attempting at operation to observe all of the niceties of surgical technic. In other words, the surgeon should get in and get out and, in general, be content to stop hemorrhage, sketchily repair important structures, and, above all, establish free drainage.

DAVIS H. PARDOLL, M.D.

Physiology of the Upper Urinary Tract. W. P. Herbst. Am. Jour. Surg., November, 1935, **30,** 317–322.

We have several methods of studying the dynamic status of the upper urinary tract, which will enable us much more accurately to classify abnormal dynamic syndromes. We have very satisfactory methods of studying the effect of drugs on the myoneural mechanism of the upper urinary tract, which will result in a much more intelligent indication for therapeutic adminstration. Renal or ureteral sympathectomy, when properly done, has no harmful effects on co-ordinated expulsive activities of the renal pelvis and ureter, and at the same time affords great relief from certain painful syndromes, and definite improvement in adynamic conditions of the upper urinary tract. The indications for presacral neurectomy are, at the present time, indefinite because of the possible production of ureterovesical incompetence, with reflux.

DAVIS H. PARDOLL, M.D.

Air in the Bile Passages: A Review and Report of a Case. Samuel Candel and William L. Wolfson. Jour. Am. Med. Assn., July 20, 1935, **105**, 188–190.

Although the literature is replete with references to internal biliary fistulas, only 43 cases have been diagnosed pre-operatively. Gas shadows in the bile passages have been observed only six times in spontaneous internal fistulas and three times after the anastomosis of the gall bladder to the stomach or the duodenum. In one reported case in spontaneous internal fistula the actual spirals of the valves of Heister were perfectly outlined by gas.

The authors report a case in which a fistula from the hepatic flexure to the gall bladder was demonstrated by use of the barium enema and a flat plate of the abdomen revealed air shadows which outlined the fistula leading from the colon into the gall bladder, the cystic duct, the dilated common duct, the hepatic ducts, and the smaller biliary radicles. The diagnosis was made pre-operatively and confirmed by operation.

C. G. Sutherland, M.B. (Tor.)

Calcifications in Seminal Vesicles and Deferent Ducts. R. Janker. Fortschr. a. d. Geb. d. Röntgenstrahlen, July, 1935, **52**, 36–43.

This is a review of the pertinent literature, with a tabulation of cases and a report concerning three cases demonstrated roentgenographically. Differential diagnosis must be made from calcifying tumor of the bladder and prostatic concrements.

H. A. Jarre, M.D.

Urinary Calculi in Paget's Disease (Osteitis Deformans). A. E. Goldstein and B. S. Abeshouse. Am. Jour. Surg., November, 1935, **30**, 327–341.

The authors' observations in six cases of urinary lithiasis in patients suffering from osteitis deformans justify the following conclusions: urinary lithiasis is an infrequent, though not uncommon, complication of osteitis deformans. Several probable etiologic factors may be considered in establishing a causal relation between osteitis deformans and urinary lithiasis: (*a*) a pathologic condition, *i.e.*, arteriosclerosis or endarteritis, affecting primarily the bones and secondarily the kidneys; (*b*) dietary deficiency; (*c*) disturbance in calcium metabolism. While the exact mechanism responsible for the formation of urinary calculi in osteitis deformans is undetermined, the authors are of the opinion that the most probable causal factor concerned in the formation of calculi in these cases is a disturbance in the calcium metabolism with an associated impairment of renal secretory function. Since experimental studies have clearly established the rôle of vitamin A deficient diets in the production of urinary calculi in the experimental animal and in the production of osteitis deformans, it is obvious that careful attention should be paid to the diet in the treatment and prevention of calculi in individuals afflicted with osteitis deformans.

Davis H. Pardoll, M.D.

GYNECOLOGY AND OBSTETRICS

Results of the Treatment of Carcinoma of the Female Genital Organs at the State Hospital for Women in Dresden, 1925–1929. H. Burckhardt. Strahlentherapie, 1935, **54**, 377.

During the period from 1925 to 1929, a total of 473 cases with carcinoma of the cervix were admitted to the State Hospital for Women. Eleven left the institution untreated and 462 received treatment; 80 were operated on and 382 were irradiated. Sixty-six cases with carcinoma of the fundus were admitted; two left untreated, 12 were operated on, and 52 were irradiated. During the same period, 31 cases of carcinoma of the vagina and 31 cases of carcinoma of the vulva were treated; also 68 cases of carcinoma of the ovary and 61 cases of recurrent carcinoma treated somewhere else before. Tables are given showing the distribution of the cases as to stages of the disease and treatment used. In carcinoma of the cervix the five-year cure in the cases operated on (77) amounted to 56 per cent, in the irradiated cases (382) to 27.4 per cent. It is interesting to note that 10.5 per cent of patients in Stage III and 4 per cent of those in Stage IV were cured. Statistics are given, then, regarding the results obtained in the various age groups. In carcinoma of the fundus, 50 per cent of the cases operated on (12) were cured and 40.4 per cent of the irradiated patients (24). The percentage of cure in carcinoma of the vagina in the one case operated on and in the irradiated cases (30) amounted to a total of 32.2. Carcinoma of the ovary was treated by operation plus irradiation (30); 26.7 per cent were cured. In conclusion, the author recommends the "elective therapy" of carcinoma of the cervix, *i.e.*, suitable cases should be operated on and others treated by irradiation.

Ernst A. Pohle, M.D., Ph.D.

HEART AND VASCULAR SYSTEM

Roentgen Symptomatology of a "Morbus ceruleus." C. W. Lohmann. Fortschr. a. d. Geb. d. Röntgenstrahlen, July, 1935, **52**, 43–52.

A report on rare clinical-roentgenologic observations in patients with marked cyanosis: (1) Three cases with a characteristic triad of cardiac malformation: congenital pulmonary stenosis, ventricular septal defect, right-turning aorta; (2) two cases of aneurysm of the pulmonary artery; one case of sclerosis of the pulmonary artery; one case of atrial septal deficiency and marked pulmonary-artery-sclerosis—the right pulmonary veins emptied into the right vena cava superior, the left into the left atrium.

H. A. Jarre, M.D.

HODGKIN'S DISEASE

The Treatment of Lymphogranulomatosis with Roentgen Rays. C. H. Flax. Strahlentherapie, 1935, **54**, 245.

The pathology, therapy, and diagnosis of Hodgkin's

disease are discussed; then follows an analysis of 54 cases seen during the last fifteen years at the Roentgen Institute in Zürich. Twenty-four patients were males and 30 females. Like most roentgenologists, the author advocates a fractional treatment with moderate doses. Deep therapy radiation is used and the single doses amount to from 240 to 360 r. In the last few years this dose has been reduced in most cases, particularly when treating mediastinal and abdominal involvement. The average duration of life since the approximate beginning of the disease amounted to 34.4 months: 40 of the total of 54 patients died after an average duration of life of 27.5 months: 14 patients are still alive and have so far reached an average duration of life of 54.2 months. As far as the prognosis is concerned, it appears that the chronic cases taking a slow course and responding well to irradiation have the longest expectancy of life. It seems beneficial to combine radiation therapy with arsenic medication. The results of roentgen therapy depend, according to the author, on early diagnosis, treatment at regular intervals, careful observation of the patient, and thorough study of the entire clinical picture.

ERNST A. POHLE, M.D., Ph.D.

THE JOINTS

X-ray Treatment of Chronic Bursitis Calcarea. F. Gleichmann. Deut. med. Wchnschr., July 19, 1935, **61**, 1163, 1164.

(Reprinted by permission from British Med. Jour., Oct. 26, 1935, p. 64 of Epitome of Current Medical Literature.)

The author discusses the treatment of chronic bursitis calcarea (peritendinitis calcificans) in the light of ten such cases given x-ray treatment during the past three years at the Charité Hospital, in Berlin. The shoulder was involved in five, the elbow in two, and the knee in three of these cases. All the patients were middle-aged, and seven of them were women. One had suffered for nine years from this complaint, which had been diagnosed as due to the imagination. In another case the disease had lasted for more than six years, and in every case it had lasted several years. In only one case was there a history of trauma (genu valgum and an operation on the knee). Under x-ray treatment the pain occasionally grew worse on the day of treatment or the next day; but as a rule this painful reaction subsided after the first two or three exposures. In the interval between two series of exposures passive and active movements were undertaken in conjunction with massage, with the object of mobilizing joints whose movements had been limited by pain.

Though the author is unable to be dogmatic over the mode of action of the x-rays in such cases, he suggests that the benefit obtained is due to local stimulation followed by hyperemia. At all events, when the correct diagnosis is made, the response of such cases to the treatment outlined above is eminently satisfactory.

THE KIDNEYS

The Roentgenologic Demonstration of the Amount of Parenchyma of a Kidney. Karl Hutter. Röntgenpraxis, October, 1935, **7**, 649–656.

The contour of the kidney shadow indicates the size of the kidney and the amount of the parenchyma, when the kidney pelvis and calices are normal on pyelograms. Excretion of dyes and of intravenously given iodine preparations may reach the same intensity and concentration in hypoplastic as in normal kidneys. Mechanical or dynamic stasis causes reduction in the amount of the parenchyma, which might be demonstrated roentgenologically by the proportion between the kidney contour and the contrast-filled pelvis and calices. The difference between hydronephrosis, with or without enlargement of the entire kidney, must be considered.

Inflammatory processes of the kidney cortex and the capsule may cause localized loss of parenchyma, which may not be visible on the contour of the kidney on roentgenograms. Dilatation of calices might take place solely by scars and without obstruction.

The shape of the upper calyx is quite often unusual, even in normal kidneys; pathologic processes may be diagnosed only when, with its dilatation, a decrease in the width of the parenchyma is apparent.

Non-specific infection of cortex and capsule may cause such marked deformities of pelvis and calices that tumors are simulated. Only the clinical history can help in such instances. In the true hypoplastic kidneys, pelves and calices are sometimes normally developed and the shadow of the parenchyma is then of great importance.

HANS W. HEFKE, M.D.

Squamous-cell Carcinoma of the Renal Pelvis. Maurice Silverstone. British Jour. Surg., October, 1935, **23**, 332-336.

Tumors of the renal pelvis form 5 to 7 per cent of all renal tumors, and these, in turn, form 0.5 to 2 per cent of all tumors, occurring in about one in every 400 patients. Ewing has divided these tumors into: (1) benign papilloma; (2) papillary epithelioma, and (3) flat or alveolar carcinoma. The condition is twice as common in males as in females, and 50 per cent of the cases occur between the ages of 40 and 60. As elsewhere in the urinary tract, squamous epithelioma arises from epithelium that has undergone metaplasia due either to infection, prolonged or of short duration but acute, or to chronic irritation, usually from stone. There are two types of tumor. In one, of which the cases reported is an example, the renal parenchyma is invaded early, the kidney being replaced by carcinoma. In the second type the renal pelvis is covered by numerous tumor masses, some of which may be papillary: the pelvi-ureteric junction is obstructed by growth so that the kidney, which is not invaded, and the pelves become hydronephrotic, and the kidney tissue atrophies. Metastases in both types are early and widespread. The cases associated with

stone usually have a long history: that of stone, and then perhaps an increase in the severity of the symptoms may make one suspect the onset of neoplasia. Hematuria in the non-papillary type occurs in about half the cases. In the majority of published cases there has been a marked loss of weight. Although diagnosis of the exact microscopic lesion is difficult, the association of hematuria with marked loss of weight should make one suspect malignant disease. Unfortunately, in a proportion of cases attention is not drawn to the kidney until the condition is inoperable. Prognosis is bad. The author reports a case of squamous-cell carcinoma of the renal pelvis, accompanied with macroscopic and microscopic sections.

DAVIS H. PARDOLL, M.D.

Traumatic Rupture of the Congenital Solitary Kidney. J. R. H. Turton and J. C. F. Lloyd-Williamson. British Jour. Surg., October, 1935, **23,** 327–331.

The authors quote a case of rupture of a congenital solitary kidney and tabulate four other cases. Rupture of congenital solitary kidney is distinctly rare. It occurs most commonly in men, usually on the left side, and in young patients, the figures in this series being: males to females, 4 to 1; left to right, 5 to 0; average age, 21 years. Unless the rupture is slight, when the diagnosis of a congenital solitary kidney has not been made, the condition has not been suspected, and has only been found postmortem. In any case of renal injury, in which nephrectomy is contemplated: (*a*) if the condition of the patient permits, intravenous pyelography should be employed as a means of demonstrating the presence of a second functioning kidney; (*b*) in the severe type, manual palpation for the contralateral kidney must be employed at operation. If rupture is proved to be that of a solitary kidney, the operative measures adopted must be conservative.

DAVIS H. PARDOLL, M.D.

Angioma of the Kidney. R. H. Jocelyn Swan and Harold Balme. British Jour. Surg., October, 1935, **23,** 282–295.

A further case of cavernous angioma of the renal pelvis is reported: 26 other cases have been collected from the literature. The diagnosis of cases of unilateral renal hematuria is fully discussed. The treatment of renal angioma is briefly discussed.

DAVIS H. PARDOLL, M.D.

THE LUNGS

The Prognosis of Carcinoma of the Lung under Roentgen Therapy. H. Holfelder. Strahlentherapie, 1935, **54,** 438.

The author reports his experience with the treatment of carcinoma of the bronchus in ten cases (four with biopsy) by roentgen rays. All patients responded at least temporarily to the treatment. Brief case histories and roentgenograms of all patients before and after irradiation are appended. The importance of early diagnosis and intensive x-ray therapy as soon as possible are emphasized.

ERNST A. POHLE, M.D., Ph.D.

THE OVARIES

The Influence of Irradiation of the Hypophysis (Radon Implantation or Roentgen Rays) on the Ovary. A. Lacassagne. Strahlentherapie, 1935, **54,** 477.

The author studied the relation between irradiation of the hypophysis and the ovary in rabbits. He developed a technic permitting the implantation of a small radon screen through trephination, which led to the destruction of the gland. The complete removal of the hypophysial function causes marked histologic and very characteristic changes in the ovary. If one-third of the anterior lobe remains intact, the normal genital functions will not be disturbed. The histologic studies of the incompletely destroyed hypophysis show that all cells of this organ are very little radiosensitive. By careful experimentation this can also be demonstrated with roentgen rays.

The author concludes from these experiments, therefore, that it would appear doubtful whether or not a therapeutic radiation of the hypophysis has any influence on the ovarian function.

ERNST A. POHLE, M.D., Ph.D.

PEPTIC ULCER

The Roentgen Diagnosis of the Sutured Perforated Duodenal Ulcer. R. Prévôt. Fortschr. a. d. Geb. d. Röntgenstrahlen, March, 1935, **51,** 273–278.

Roentgenologic examination of the alimentary canal four weeks following suture of a ruptured duodenal ulcer usually can demonstrate the location of the suture, especially on exploration of the mucosal relief, because the inverted mucosal margins produce a characteristic filling defect. Following such operation, at times, stenoses of the duodenum occur, reversible ones resulting from congestion and edema of the mucosa. They usually respond to conservative internal management; permanent cicatrizing ones may require secondary resection.

H. A. JARRE, M.D.